TESTMASTER™

SPLICER'S TEST SET

MODEL 108

OPERATING INSTRUCTIONS

Industrial Technology

Addendum No. 1
October 1974

EXPANDED PROCEDURE FOR FLUTTER CALIBRATION OF THE MODEL 6500 RECORDER TEST SET

1-1. GENERAL

1-2. The flutter calibration procedure presented in this manual addendum is more detailed than that given in the maintenance section of the manual. Either procedure may be used depending upon individual requirements.

1-3. Figure 1 is a block diagram of the required test equipment setup. The referenced test equipment is that recommended in the manual. Equivalent equipment can be used.

1-4. Flutter Calibration Procedure:

1. Connect test equipment as shown in figure 1. Turn on test equipment and M6500 power and allow a nominal 15 minute warm-up period.

2. Disconnect the modulation input from the voltage controlled oscillator (VCO). Set the VCO output level to approximately 1 volt rms (use ac voltmeter) and the output frequency to 1.0 kHz.

3. Connect the modulation input to the VCO. Set the modulation signal generator frequency to approximately 100 Hz (dial accuracy). Set the output level to a nominal 1.0 volts rms.

4. Observe the frequency counter reading and adjust the "Zero Adjust" control on the modulation signal generator as required to bring the counter reading back to 1.0 kHz. (This procedure "nulls out" any significant dc component present in the output of the modulation signal generator.)

5. Set the modulation signal generator to produce a 0.1 Hz square wave (dial accuracy). Adjust the output level of the signal generator as required to produce the desired % modulation.

   EXAMPLE: To calibrate for 1% flutter, multiply 1% (.01) times the carrier frequency (1000 Hz) to obtain the required frequency deviation. In this instance, the deviation will be ±10 Hz and the carrier will fluctuate between 990 Hz and 1010 Hz. If the deviation is not symmetrical about 1000 Hz, a dc component is still present in the modulating signal. Touch up the "Zero Adjust" control of the modulation signal generator as required to obtain deviation symmetry.

6. Note the voltage extremes (maximum + and – levels) of the modulating signal as indicated on the dc voltmeter. The levels should be reasonably symmetrical around zero. A relative minor discrepancy in symmetry is acceptable (i.e.: +2.39 volts and –2.21 volts is satisfactory), however, a large difference (i.e.: +3.5 volts and –1.2 volts) is excessive and the procedure should be repeated to minimize the dc component in the modulating signal.

NOTE

If step 6 symmetry cannot be achieved through the procedure, it is possible that the VCO response is not linear.

7. Reset the modulation signal generator to give a 20 Hz sine wave (dial accuracy). Use the ac voltmeter to set the generator output level to an rms value which is equal to one half of the absolute value of the sum of the dc voltages noted in step 6. Example: If the dc values are +2.39 volts and –2.21 volts, the absolute value is 4.6 volts. One half of 4.6 volts is 2.3 volts and is the value to which the generator output level is set. Using the technique just described, automatically converts from % peak modulation which is obtained using a square wave (step 5) to the equivalent % RMS modulation using a sine wave. (The Model 6500 is calibrated to RMS flutter values.)

8. Set the TEST switch to the SET position and select the desired recorder type (A, B, or C). Adjust the REFERENCE SET control to obtain a SET indication on the test set meter.

9. Set the TEST switch to the FLUT (2) position and adjust the appropriate potentiometer (see below) to cause the meter to read in the SET zone.

   Adjust R154 for Type A Recorders
   Adjust R155 for Type B Recorders
   Adjust R156 for Type C Recorders

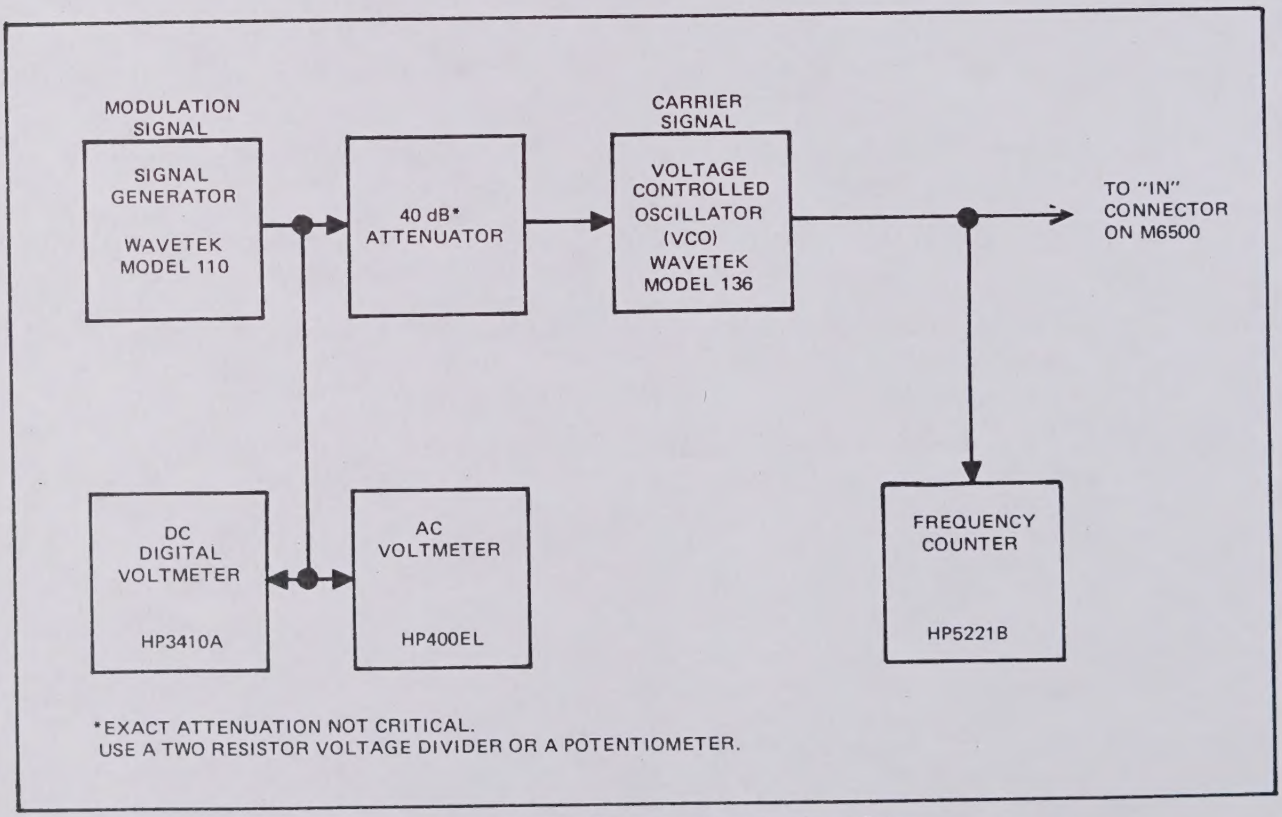

Figure 1. M6500 Flutter Calibration Test Setup

MANUAL ADDENDUM
MODEL 6500-1676

1-1. GENERAL

1-2. The Model 6500-1676 is identical to the standard Model 6500 except for the following changes to specifications and parts listed below.

1-3. SPECIFICATIONS

	Recorder Type		
	A	B	C
Output from Test Set	0 dbm	0 dbm	0 dbm
Input from Recorder	0 dbm	0 dbm	0 dbm
Low Frequency	300 Hz	100 Hz	50 Hz
High Frequency	3 KHz	8 KHz	16 KHz
Distortion	3%	3%	3%
Flutter	1%	0.5%	0.15%
Signal to Noise	30 db	40 db	50 db

1-4. PARTS LISTS

1-5. Change the following Parts Lists to reflect the following changes:

Assembly	Ref. Des.	Description	Data Check P/N
6500-0230-10	R116, R119	33.2K ohm, 1/8W, 1%	5-51349
6500-0240-10	R122, R125	51.1K ohm, 1/8W, 1%	5-51367
6500-0220-10	R137, R143	51.1K ohm, 1/8W, 1%	5-51367
6500-0200-00	CR14	IN4148	3-10914

1-6. MAINTENANCE

1-7. Make the following changes to Section IV Maintenance:

1. Low Frequency Oscillator - Step 3.
   Adjust R7 for 1.0 V RMS indication on the VTM. The waveform should be a clean sinewave and the frequency counter should read 300 Hz +/−15 Hz.

2. High Frequency Oscillator - Step 3.
   Adjust R31 for a 1.0 V RMS indication on the VTM. The waveform should be a clean sinewave and the frequency counter should read 3 KHz +/−150 Hz.

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SECTION I
GENERAL DESCRIPTION

GENERAL

The Model 6500 Recorder Test Set is manufactured by Data Check Corporation of San Diego, California. It is a portable, solid-state test instrument for evaluating the performance of a wide range of audio tape recorders. The instrument is intended to be used by unskilled operators and features "GO" – "NO GO" performance readouts. The readouts are by meter indication against calibrated color coded scales. A built-in self-test feature permits verification of correct test set function for any performance test. Upon observation of an unsatisfactory performance readout, a touch of the self-test button will provide an alternate meter indication to confirm proper function of the test set. If the self-test readout is correct, the performance of the recorder under test is not acceptable. The test set is available in a battery-operated configuration or with an ac power pack operated from normal line power (nominal 115/230 vac, 60 Hz).

The Model 6500 divides audio recorders into three general classifications for test purposes. Recorders are identified as Type A, Type B, or Type C, dependent upon the general classification to which they belong. Type A audio recorders are generally rather low quality, low speed, limited response recorders with the primary purpose of voice recording. The recorder may have automatic record level (ARL) control, a manual record gain control, or both. It may or may not have a record level indicator, reproduce level indicator, or reproduce gain control. Type B audio recorders are medium quality home recorders. They usually do not have simultaneous record and playback capability. They normally have record and reproduce level controls and indicators which are often shared between record and reproduce functions. Type B recorders may also have switch selectable automatic record level (ARL) controls. Normal use is for voice, music, and, depending on format, some data recording (such as low frequency carriers with medical information) is possible. Type C recorders include the top line home recorders and professional audio recorders. These recorders have simultaneous record and reproduce capability, separate record and reproduce gain controls, monitor metering, and some form of counter to locate a specific section of tape. They are used for recording voice, music, and a variety of low frequency data.

The Model 6500 Recorder Test Set provides separate switch selectable test parameters for each recorder type. Table 1-1 lists the parameters tested and their limits as applicable to each recorder classification.

Model 6500 tests are based on recording a test tape on the recorder to be evaluated. The test set supplies a composite test signal consisting of a mix of the lower band edge frequency, a reference frequency, and the upper band edge frequency. To insure the ability to record the reference frequency at normal record level and at the same time avoid tape saturation at band limits, the amplitudes of the low and high frequency components are supplied 12 and 18 dB, respectively, below the reference frequency level. (See specifications for applicable frequencies.) The test tape consists of a two minute recording of the composite signal (recorded at normal record level) immediately followed by a 30 second recording made with a zero signal level input to the recorder. The test tape is then rewound and played back. The level of the reproduced reference frequency is used directly when checking reproduce level, distortion, or flutter and as a reference when making frequency response and signal-to-noise tests. For those systems which have simultaneous record/reproduce capabilities (normally Type C recorders), the performance testing can be accomplished concurrently with the test tape recording process.

Table 1-1. Test Parameters and Limits, Type A, B, and C Audio Recorders

Output Level, MIC (Microphone):	1.0 millivolts rms nominal for all recorder types. (Can be calibrated for 100 microvolts to 1 millivolt rms.)
Output Level, LINE:	1.0 volts rms, nominal for all recorder types. (Can be calibrated for 100 millivolts to 1 volt rms.)
NOTE	
MIC (Microphone) or LINE Output Level (OUT from test unit) is selected by a slide switch on the front panel of the test unit. The level cannot be calibrated separately.	
Reproduce Level:	1.0 volts rms ±3 dB, nominal for all recorder types. (Can be calibrated for 0.1 to 1 volt rms.)
Distortion:	3% third harmonic of the 1000 Hz reference, nominal for all recorder types. (Can be calibrated from 1% to 3%.)
Frequency Response:	
Type A Recorder:	±3 dB 200 Hz to 4 kHz from 1000 Hz reference.
Type B Recorder:	±3 dB 100 Hz to 8 kHz from 1000 Hz reference.
Type C Recorder:	±3 dB 50 Hz to 16 kHz from 1000 Hz reference.
Flutter:	
Type A Recorder:	1.5% rms, nominal. (Can be calibrated for 0.15 to 3% rms.)
Type B Recorder:	0.5% rms, nominal. (Can be calibrated for 0.15 to 3% rms.)
Type C Recorder:	0.15% rms, nominal. (Can be calibrated for 0.15 to 3% rms.)
Signal-to-Noise:	
Type A Recorder:	25 dB from 1000 Hz reference, nominal. (Can be calibrated from 20 to 50 dB.)
Type B Recorder:	40 dB from 1000 Hz reference, nominal. (Can be calibrated from 20 to 50 dB.)
Type C Recorder:	50 dB from 1000 Hz reference, nominal. (Can be calibrated from 20 to 50 dB.)

The Model 6500 Recorder Test Set is ideally suited for production line testing. The "GO" - "NO GO" readout and self-test feature, which allows immediate elimination of the test set as a possible contributory factor, gives maximum performance evaluation in minimum time and permits use of unskilled personnel. Although primarily designed for testing audio recorders, the Model 6500 can be used for performance testing of any audio device if the test parameters it supplies are acceptable for defining the performance of the device. Examples of such devices are:

Audio Multiplex Systems.

Audio Power Amplifiers.

Voice Logging Tape Recorders.

The recorder test set is also a suitable lab test instrument for troubleshooting and repair of defective systems. It combines functions of a signal generator, vtvm, distortion analyzer, and audio flutter meter. The sequential performance tests provide considerable insight into the nature and probable circuit location of system failures.

SPECIFICATIONS

Table 1-2 lists the specifications applicable to the Model 6500 Recorder Test Set.

NOTE

Those functions for which separate calibration adjustments are provided are noted as having Type A, B, and C calibration.

Table 1-2. Model 6500 Recorder Test Set Specifications

OUTPUT SIGNAL (Composite Test Signal)

Level: (A, B, and C Calibration.)
Microphone: 100 μV to 1 mV RMS.
Line: 100 mV to 1 V RMS.
Distortion: < 0.1% second and < 0.1% third
Impedance: Line: < 600 ohms
Microphone: < 1 ohm
Frequencies:

Type	Low f	Reference f	High f
"A"	200 Hz	1 kHz	4 kHz
"B"	100 Hz	1 kHz	8 kHz
"C"	50 Hz	1 kHz	16 kHz

INPUT SIGNAL (Reproduce Input)

Level: 100 mV to 1 V RMS (A, B, and C calibration) (not to exceed 25V RMS, 200 V DC, or 50 V Peak).
Impedance: 100 kΩ shunted by < 100 pF for signals of less than 2 V RMS.

FUNCTION TESTS

Low Frequency: Green Reading within ±3 dB relative to 1 kHz. Yellow Reading within ±6 dB relative to 1 kHz.
High Frequency: Green Reading within ±3 dB relative to 1 kHz. Yellow Reading within ±6 dB relative to 1 kHz.
Distortion: Measures third harmonic distortion of 1 kHz reference signal. Individual A, B, and C Calibration Range: 1% to 3%.
Flutter: Measures flutter of 1 kHz reference signal. Individual A, B, and C Calibration Range: 0.15% to 3% RMS, Bandwidth 0.5 Hz to 100 Hz unweighted and damped.
Signal-to-Noise: Measures signal-to-noise ratio relative to 1 kHz reference signal. Individual A, B, and C Calibration Range: −20 dB to −50 dB.
Self-Test: Self-test feature allows verification of proper operation of each test function.
Connectors: BNC Type.

Table 1-2. Model 6500 Recorder Test Set Specifications (Cont.)

POWER

AC Power Version (Standard): 115V/230V ±10%, 50 - 60 Hz, less than 1 VA.

Power Cable: Three-wire, grounded.

Battery Power Version (Optional): 6 ANSI "D" Cells (not included).

Life: 90 days at 2 hours a day.

Current Drain: Fresh Cells – 30 mA.
End-of-Life – 18 to 21 mA.

MOUNTING

Standard: Portable bench mount with carrying handle.

Optional: Rack mount.

DIMENSIONS

10-3/4" (27.3 cm) W (including carrying handle), x 12" (30.4 cm) D x 5-1/2" (13.9 cm) H

WEIGHT

Less than 10 lbs. (4.53 kg)

AMBIENT TEMPERATURE RANGE

Operational: 0° to +50°C
Non-operational: -28° to +65°C

HUMIDITY

Up to 95% without condensation.

OPTIONS

Battery Pack (see above)
Rack Mount Kit

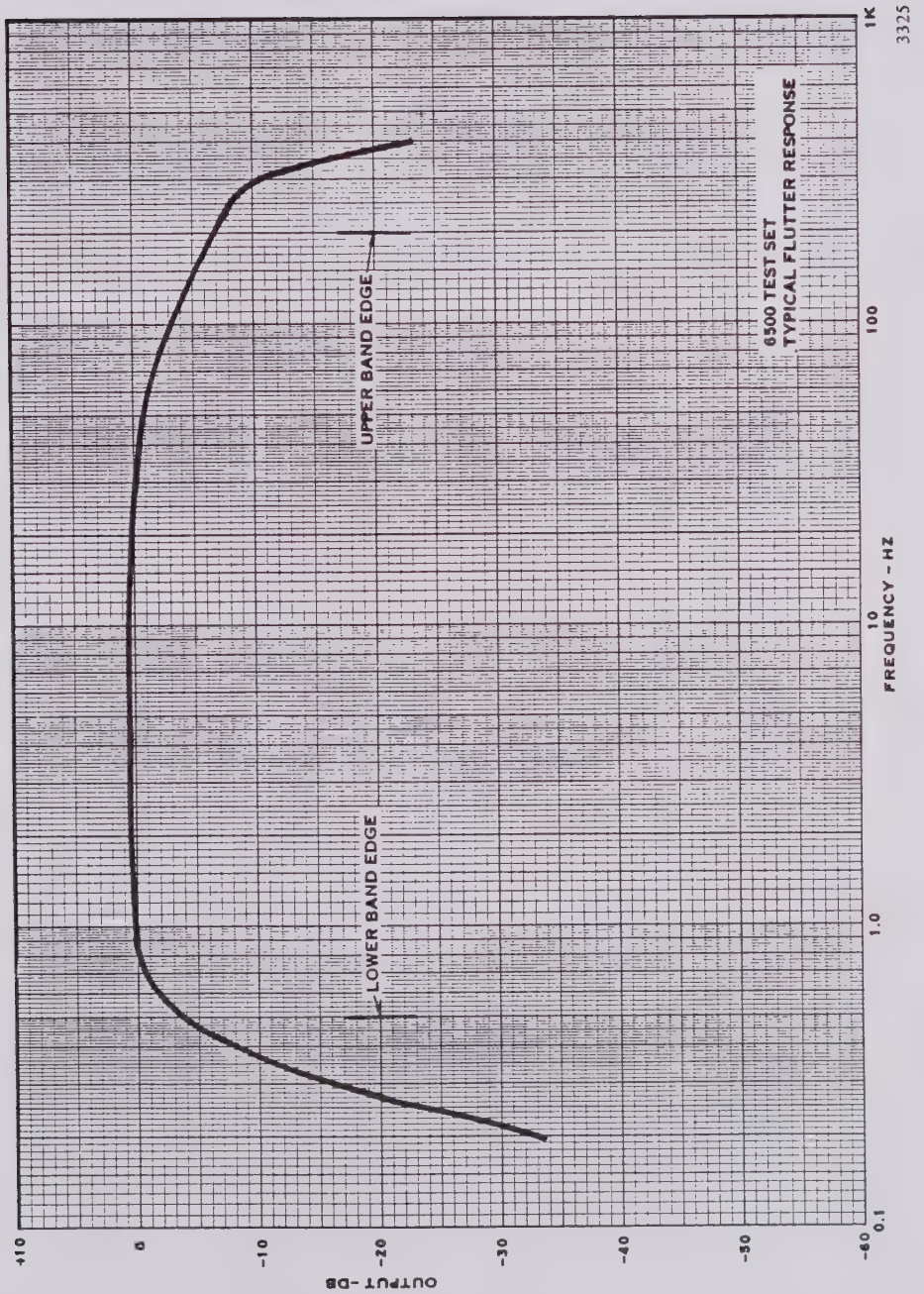


Figure 1-1. Flutter Response Bandwidth (Graph I)

SECTION II
INSTALLATION

RECEIPT INSPECTION

The Model 6500 Recorder Test Set is inspected and operationally checked prior to leaving the factory. A visual inspection for shipping damage should be made and, if inspection reveals any damage, the carrier should be notified immediately.

LOCATION CONSIDERATIONS

The Model 6500 Recorder Test Set may be used in almost any location, so long as reasonable judgement is used with regard to environment (see specifications). Visual and physical access to the front panel of the instrument is required.

SIGNAL CONNECTIONS

Interconnecting cables are not provided with the instrument. The wide interface possibilities preclude the use of standard interconnect cables. The test set requires BNC connector interface.

POWER

The Model 6500 Recorder Test Set is supplied with an ac power pack or a battery power pack.

The ac power pack operates from a 115/230 volts, 60 Hz line source. A power switch located on the rear panel of the instrument must be placed in the position which corresponds to the line source being used.

CAUTION

Damage to the instrument can occur if the unit is operated with the power switch in the wrong position.

The battery power pack employs six "D" size cells connected in series to provide ±4.5 volt dc supplies. The unit is shipped without batteries.

BATTERY INSTALLATION

Batteries are installed on the inside of the rear panel of the instrument. Access is obtained by removing the rear panel which is secured by five screws. The batteries are installed in an alternating front-to-back arrangement and polarity is clearly marked.

SECTION III
OPERATION

GENERAL

The Model 6500 Recorder Test Set must be lab-calibrated for the system(s) to be tested. (The required calibration procedure is presented in the maintenance section of this manual.) Once calibration has been accomplished, the procedures presented under OPERATION are applicable. Step-by-step procedures are also provided under a transparent cover on the top of the unit. The procedure card is two-sided. One side covers systems which do not have simultaneous record/reproduce capability; the opposite side provides a procedure for systems possessing this capability.

Conventionally accepted performance for frequency response is ±3 dB (green zone on the upper scale) from a reference frequency. In many applications, however, ±6 dB is equally acceptable. The Model 6500 recognizes this situation and provides a YELLOW scale to define the ±6 dB limits.

CONTROLS AND INDICATORS

All operating controls and indicators are located on the front panel of the instrument. (Signal input and output connectors are located on both the front panel and the rear panel.) Table 3-1 lists each front panel control, indicator, and signal connector and gives a brief functional description. Figure 3-1 provides identification and location data.

OPERATING INSTRUCTIONS

The switches and connectors on the Model 6500 Recorder Test Set (see figure 3-1) are clearly labeled according to function. Operation of the test set consists of making the proper connections between the unit and the recorder to be tested (IN and OUT connections may be made at the rear panel if desired), selecting the proper recorder type and record input, then performing the appropriate test procedure. Two procedures are supplied. Procedure I is applicable to recorders which do not have simultaneous record/reproduce capability. Procedure II is used with systems which do have this capability.

The Model 6500 Recorder Test Set has a SELF TEST feature incorporated. A properly calibrated unit will read center scale (between SET limit marks) for all test functions except BATT and REC II. When the TEST switch is in either of these positions, the meter must read above the BATT OK line to indicate correct instrument performance. SELF TEST is enabled by pressing (and holding) the SELF TEST switch.

NOTE

The record output level may change while the SELF TEST switch is depressed.

Table 3-1. Controls, Indicators, and Signal Connectors

TITLE	FUNCTIONAL DESCRIPTION
CONTROLS	
RECORDER TYPE Switch	Configures test parameters for recorder type to be tested. (See DESCRIPTION for recorder classifications.)
REFERENCE SET Control	Controls reproduce input level indication (in SET position of TEST switch) to permit establishment of reference level for tests.
SELF TEST Switch	Momentary contact switch for checking test unit function for each performance test. Meter reads center scale for all test conditions except BATT and REC II. In these positions satisfactory performance is for meter to read in BATT OK zone.
MIC/LINE Switch	Selects the basic output level from the test set. (Signal to be recorded.)
MIC	100 μvolts to 1.0 millivolts rms.
LINE	100 millivolts to 1.0 volt rms.
POWER Switch	Alternate action switch (press to actuate-press to release). Applies power to unit when on. Fluorescent area (orange) in center of switch is exposed when switch is in ON condition.
TEST Switch	Controls test signals and establishes test parameters.
OFF	Start and end position of TEST switch. Amplifier gains are reduced.
BATT	Battery test position. Battery condition is acceptable when meter reads on or above BATT OK line on meter scale 1.
REC I	Unit supplies composite test signal to be recorded. Amplitude of signal is a function of calibration and position of MIC/LINE switch. It is recommended that a two minute recording be made to allow ample time for performance tests.
REC II	Unit provides a "no signal out condition" to the recorder input. It is recommended that a 30 second REC II input recording immediately follow REC I.
LEVEL (1)	Verifies proper reproduce level from the recorder. Meter should read in the GREEN on meter scale 1 when reproducing the REC I recording. If recorder has a reproduce level control, it must be used (as required) to obtain in the GREEN indication.
SET	Enables REFERENCE SET control to allow meter indication to be adjusted to SET line on meter scale 1.
LOW F (1)	Verifies proper reproduce level of low frequency component of composite test signal. Meter must read in the GREEN of meter scale 1 for ±3 dB response relative to 1 kHz reference or in YELLOW for ±6 dB response.
HI F (1)	Verifies proper reproduce level of high frequency component of composite test signal. Meter must read in the GREEN of meter scale 1 for ±3 dB response, relative to 1 kHz reference or in YELLOW for ±6 dB response.
DIST (2)	Checks third harmonic content of reference frequency component of composite test signal. Meter must read in the GREEN of meter scale 2 for performance to be acceptable.
FLUT (2)	Checks the flutter (tape speed variation) by measuring frequency deviations in reference frequency. Meter must read in the GREEN of meter scale 2 for performance to be acceptable.

Table 3-1. Controls, Indicators, and Signal Connectors (Cont.)

TITLE	FUNCTIONAL DESCRIPTION
CONTROLS (Cont.)	
LEVEL II	Allows monitoring of reproduce output from recorder. The output should initially read in the GREEN on meter scale 1. When meter indication drops into the RED at the conclusion of the REC I recording, switch to the SNR position.
SNR (2)	Signal-to-noise test. Meter must read in the GREEN of meter scale 2 for performance to be acceptable
INDICATORS	
Power On	The power on indicator is an orange fluorescent area in the center of the POWER switch which is hidden when the switch is in the off position.
METER	DC readout meter. Reads actual or relative levels. Has two scales which are color coded for "GO" - "NO GO" readouts. The top scale is calibrated in dB; the bottom scale is in % of specified performance. The scale junction (BATT OK line) equals 100% of specified performance.
CONNECTORS	
IN Connector	Input connector to test set. Reproduce output from recorder under test is connected here. (A parallel wired IN connector is also located on the rear panel for convenience.)
OUT Connector	Test signal output from test set. This signal is connected to the record input of the recorder under test. (A parallel wired OUT connector is also located on the rear panel for convenience.)

INITIAL SETUP PROCEDURE

RECORDER

NOTE

Some recorders have TONE controls. These controls modify the frequency response of the recorder and must be set to approximately mid-range (or to their normal operating position) prior to beginning test.

1. Turn on recorder power.
2. Load recorder with tape.

NOTE

For recorders which do not have simultaneous record/reproduce capability, rewind tape to beginning of reel. (To identify starting point of test recording.)

3. Connect reproduce output of the recorder to the IN connector (front or rear panel) on the test set.
4. Connect recorder record input to the OUT connector (front or rear panel) on the test set.

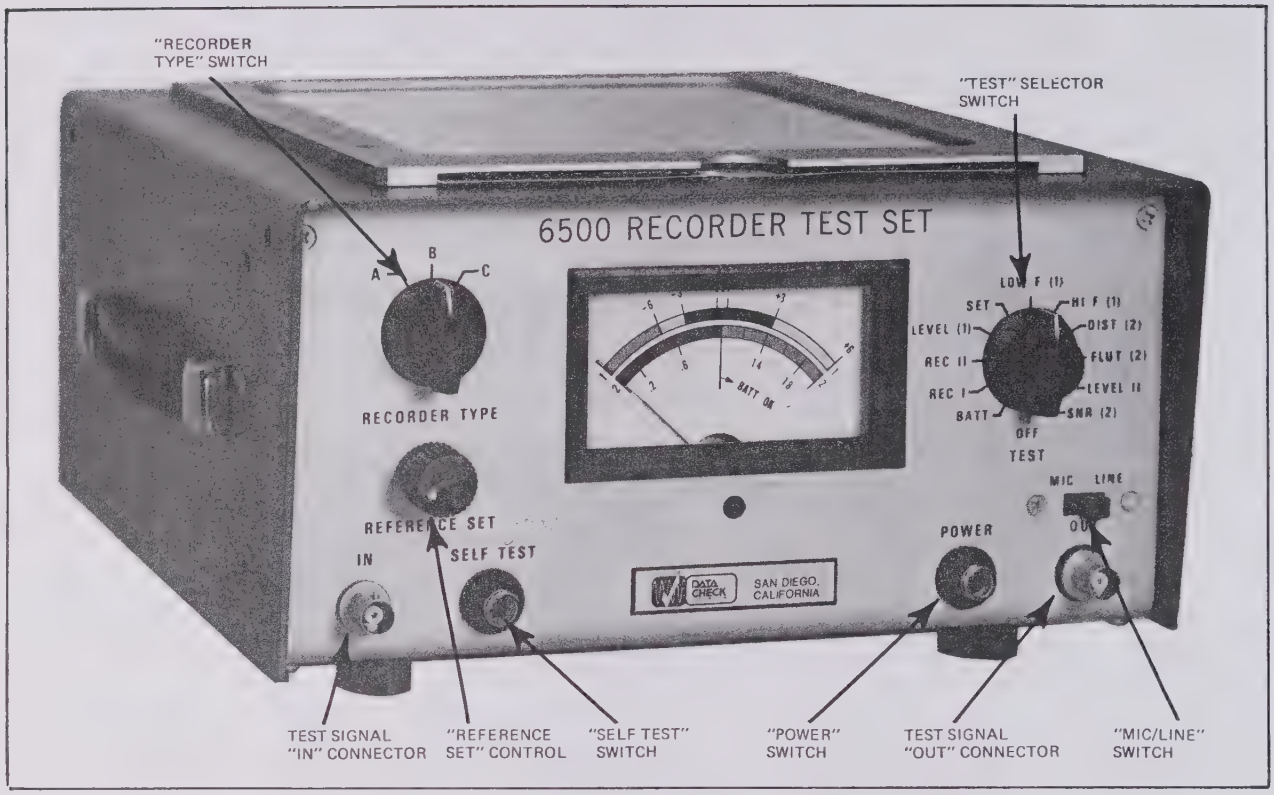


Figure 3-1. Location of Controls, Indicators, and Connectors

INITIAL SETUP PROCEDURE (Cont.)

TEST SET

1. Set the RECORDER TYPE switch to the appropriate position. (See Section I for recorder classification data.)
2. Set the MIC/LINE switch to the position which corresponds to the record input characteristics of the recorder to be tested.
3. Check the power source selector switch on the rear panel of the unit for a setting which corresponds to the power source being used. This step is not applicable to units with the battery power pack.
4. Turn on test set power by pressing the POWER switch.

NOTE

Maximum life for the battery power pack is obtained by turning off power when not actually making tests. The unit does not require warm-up time.

TEST PROCEDURE I – FOR RECORDERS WITHOUT SIMULTANEOUS RECORD/REPRODUCE

NOTE

WAIT 5 SECONDS BEFORE TAKING READINGS TO ALLOW METER TO STABILIZE.

SET TEST SWITCH TO POSITION	
BATT	METER MUST READ IN **BATT OK** ZONE. IF **OK**, SWITCH TO **REC I** AND PROCEED. IF LOW, SET SWITCH TO **OFF** AND TURN **POWER** OFF. REFER TO INSTRUCTION MANUAL FOR BATTERY REPLACEMENT OR POWER SUPPLY MAINTENANCE.
REC I	METER MUST READ IN **GREEN** ON SCALE 1. PLACE RECORDER IN RECORD MODE, SET RECORD GAIN (IF ANY) FOR NORMAL AND RECORD FOR 2 MINUTES, THEN SWITCH TO **REC II** AND CONTINUE RECORDING FOR 30 SECONDS. IF METER READING IS NOT IN **GREEN** ZONE, **TEST SET** IS MALFUNCTIONING. SET SWITCH TO **OFF** AND TERMINATE TEST.
REC II	IN **REC II** THE METER MUST INDICATE IN **BATT OK** ZONE. REWIND TAPE TO BEGINNING OF RECORDING, SWITCH TO **LEVEL (1)** AND PROCEED. IF METER READING IS NOT IN **BATT OK** ZONE, **TEST SET** IS MALFUNCTIONING. SET SWITCH TO **OFF** AND TERMINATE TEST.
LEVEL (1)	PLACE RECORDER IN **PLAY**, SET REPRODUCE GAIN (IF ANY) FOR A METER READING IN THE **GREEN** ON SCALE 1 (**YELLOW**, IF COVERED UNDER SEPARATE INSTRUCTIONS), SWITCH TO **SET** AND PROCEED. IF METER READING IS NOT IN **GREEN** (OR **YELLOW** PER ABOVE), SWITCH TO **OFF** AND REJECT RECORDER.
SET	ADJUST **REFERENCE SET** CONTROL AS REQUIRED TO BRING METER POINTER INTO THE **SET** ZONE (CENTER OF SCALE 1), SWITCH TO **LOW F (1)** AND PROCEED.
LOW F (1)	METER IN **GREEN** ON SCALE 1 (**YELLOW** IF COVERED UNDER SEPARATE INSTRUCTIONS), TEST **OK**, SWITCH TO **HIGH F (1)** AND PROCEED. IF NOT IN **GREEN** (OR **YELLOW** PER ABOVE), SWITCH TO **OFF** AND REJECT RECORDER.
HIGH F (1)	METER IN **GREEN** ON SCALE 1 (OR **YELLOW** IF COVERED UNDER SEPARATE INSTRUCTIONS), TEST **OK**, SWITCH TO **DIST (2)** AND PROCEED. IF NOT IN **GREEN** (OR **YELLOW** PER ABOVE), SWITCH TO **OFF** AND REJECT RECORDER.
DIST (2)	METER IN **GREEN** ON SCALE 2, SWITCH TO **FLUT** AND PROCEED. METER IN **RED**, SWITCH TO **OFF** AND REJECT RECORDER.
FLUT (2)	METER IN **GREEN** ON SCALE 2, SWITCH TO **LEVEL II** AND PROCEED. METER IN **RED**, SWITCH TO **OFF** AND REJECT RECORDER.
LEVEL II	METER IN **GREEN** ON SCALE 1, WAIT FOR LEVEL TO DROP INTO **RED** THEN SWITCH TO **SNR** AND PROCEED. IF METER STARTS IN **RED** ON SCALE 1, REWIND TO BEGINNING, PLACE RECORDER IN **PLAY** AND REPEAT **DIST**, **FLUT** AND **LEVEL II**.
SNR (2)	METER IN **GREEN** ON SCALE 2, RECORDER **OK**, SWITCH TO **OFF** AND PROCEED. METER IN **RED**, SWITCH TO **OFF** AND REJECT RECORDER.
OFF	REWIND TAPE, DISCONNECT CABLES, AND TURN OFF RECORDER AND TEST SET POWER. END OF TEST.

TEST PROCEDURE II – FOR RECORDERS WITH SIMULTANEOUS RECORD/REPRODUCE

NOTES

DIAL THROUGH SWITCH POSITIONS NOT LISTED.

WAIT 5 SECONDS BEFORE TAKING READINGS TO ALLOW METER TO STABILIZE.

SET TEST SWITCH TO POSITION	
BATT	METER MUST READ IN **BATT OK** ZONE. IF **OK**, SWITCH TO **REC I** AND PROCEED. IF LOW, SET SWITCH TO **OFF**, TURN **POWER** OFF AND REFER TO INSTRUCTION MANUAL FOR BATTERY REPLACEMENT OR POWER SUPPLY MAINTENANCE.
REC I	METER MUST READ IN **GREEN** ON SCALE 1. PLACE RECORDER IN RECORD MODE, SET RECORD GAIN (IF ANY) FOR NORMAL, SWITCH TO **LEVEL (1)** AND PROCEED. IF NOT IN **GREEN, TEST SET** MALFUNCTIONING. SWITCH TO **OFF** AND TERMINATE TEST.
LEVEL (1)	SET REPRODUCE GAIN (IF ANY) FOR A METER READING IN THE **GREEN** ON SCALE 1, (**YELLOW**, IF COVERED UNDER SEPARATE INSTRUCTIONS). SWITCH TO **SET** AND PROCEE IF METER READING IS NOT IN **GREEN** (OR **YELLOW** PER ABOVE), SET SWITCH TO **OFF** AN REJECT RECORDER.
SET	ADJUST **REFERENCE SET** CONTROL AS REQUIRED TO BRING METER POINTER INTO THE **SET** ZONE (CENTER OF SCALE 1). SWITCH TO **LOW F (1)** AND PROCEED.
LOW F (1)	METER IN **GREEN** ON SCALE 1 (OR **YELLOW** IF COVERED UNDER SEPARATE INSTRUCTIO TEST **OK**, SWITCH TO **HIGH F (1)** AND PROCEED. IF NOT IN **GREEN** (OR **YELLOW** PER ABOVE), SWITCH TO **OFF** AND REJECT RECORDER.
HIGH F (1)	METER IN **GREEN** ON SCALE 1 (OR **YELLOW** IF COVERED UNDER SEPARATE INSTRUCTIO TEST **OK**, SWITCH TO **DIST (2)** AND PROCEED. IF NOT IN **GREEN** (OR **YELLOW** PER ABOVE), SWITCH TO **OFF** AND REJECT RECORDER.
DIST (2)	METER IN **GREEN** ON SCALE 2, SWITCH TO **FLUT** AND PROCEED. METER IN **RED**, SWITCH TO **OFF** AND REJECT RECORDER.
FLUT (2)	METER IN **GREEN** ON SCALE 2, SWITCH TO **LEVEL II** AND PROCEED. METER IN **RED**, SWITCH TO **OFF** AND REJECT RECORDER.
LEVEL II	METER IN **GREEN** ON SCALE 1, WAIT FOR LEVEL TO DROP INTO **RED** THEN SWITCH TO **SNR** AND PROCEED. (NOTE, GREEN READING IS SHORT TERM.)
SNR (2)	METER IN **GREEN** ON SCALE 2, RECORDER **OK**, SWITCH TO **OFF** AND PROCEED. METER IN **RED**, SWITCH TO **OFF** AND REJECT RECORDER.
OFF	REWIND TAPE, DISCONNECT CABLES, AND TURN OFF RECORDER AND TEST SET POWER. END OF TEST.

SECTION IV
MAINTENANCE

GENERAL

The Model 6500 Recorder Test Set, a precision solid-state test instrument, has been designed to provide long trouble-free service without maintenance or adjustment. If a malfunction in the test set should occur, follow procedures in this section to troubleshoot and correct the problem.

TEST EQUIPMENT REQUIRED

The test equipment recommended for servicing the Model 6500 Recorder Test Set is listed in table 4-1. Equivalent instruments may be substituted.

Table 4-1. Recommended Test Equipment

INSTRUMENT TYPE	RECOMMENDED MODEL
DC Digital Voltmeter	HP Model 3430A
AC VTVM	HP Model 400EL
Oscilloscope	Tektronix Model 422
Frequency Counter	HP Model 5221B
Signal Generator	Wavetek Model 110
Voltage Controlled Oscillator	Wavetek Model 136

ALIGNMENT, CALIBRATION, AND TEST

The alignment, calibration, and test procedures are presented as a complete alignment, calibration, and test sequence for the Model 6500 Recorder Test Set. The procedures are inter-related and should be performed in the sequence indicated. Figure 4-1 provides location data for the various adjustments referenced in the procedures. Access is obtained by removing the top cover of the instrument which is secured by 8 Phillips-head screws. (One screw in each upper corner of the front and rear panels and one at each corner on the bottom of the unit.) It is recommended that a complete alignment of the unit be performed (or verified) at six-month intervals.

NOTE

The procedures pre-suppose that instruments with the ac power pack have been properly connected to a suitable line source and that the power select switch on the rear panel has been set to the position which corresponds to that source.

The alignment, calibration, and test procedures are as follows:

POWER TESTS:

1. Turn on power by depressing POWER switch (fluorescent area at center of switch is exposed).
2. Connect the dc voltmeter between E33 (+) and ground (–).
3. Place TEST switch in BATT position. The voltmeter should read 3.0 to 5.0 volts dc.

4. Connect the dc voltmeter between E32 (–) and ground (+). The voltmeter should read 3.0 to 5.0 volts dc.
5. If either step 3 or step 4 is not satisfactory, turn off power by depressing POWER switch. Refer to Section II for battery replacement information or to the troubleshooting portion of this section for ac power pack problems.
6. When steps 3 and 4 are satisfactory, the test meter shall indicate above the BATT OK line.

COMPOSITE SIGNAL TEST/ALIGNMENT

REFERENCE OSCILLATOR:

1. Connect the ac vtvm, frequency counter, and oscilloscope to TP1.
2. Set the TEST switch to REC I position.
3. Adjust R20 for a 1.0 volts rms indication on the vtvm. The waveform should be a clean sinewave with no visible distortion and the frequency counter should read 1000 Hz ±50 Hz.

LOW FREQUENCY OSCILLATOR:

1. Connect the ac vtvm, frequency counter, and oscilloscope to TP2.
2. Set the RECORDER TYPE switch to A.
3. Adjust R7 for a 1.0 volts rms indication on the vtvm. The waveform should be a clean sinewave and the frequency counter should read 200 Hz ±10 Hz.
4. Set the RECORDER TYPE switch to B. The vtvm should read within ±0.5 dB of 1.0 volts rms, the waveform should be a clean sinewave, and the frequency counter should read 100 Hz ±5 Hz.
5. Set the RECORDER TYPE switch to C. The vtvm should read within ±0.5 dB of 1.0 volts rms, the waveform should be a clean sinewave, and the frequency counter should read 50 Hz ±3 Hz.

NOTE

The most probable cause of failure of oscillator amplitude to remain constant with changing frequency is a value imbalance between the resistors which determine frequency. Refer to Section V for level or frequency problems.

HIGH FREQUENCY OSCILLATOR:

1. Connect the ac vtvm, frequency counter, and oscilloscope to TP3.
2. Set the RECORDER TYPE switch to A.
3. Adjust R31 for a 1.0 volts rms indication on the vtvm. The waveform should be a clean sinewave with no visible distortion and the frequency counter should read 4.0 kHz ±200 Hz.
4. Set the RECORDER TYPE switch to B. The vtvm should read within ±0.5 dB of 1.0 volts rms, the waveform should be a clean sinewave, and the frequency counter should read 8.0 kHz ±400 Hz.
5. Set the RECORDER TYPE switch to C. The vtvm should read within ±0.5 dB of 1.0 volts rms, the waveform should be a clean sinewave, and the frequency counter should read 16.0 kHz ±800 Hz.

NOTE

The most probable cause of failure of oscillator amplitude to remain constant with changing frequency is a value imbalance between the resistors which determine frequency. Refer to Section V for level or frequency problems.

COMPONENT LEVEL VERIFICATION (COMPOSITE SIGNAL)

1. Connect the ac vtvm to the OUT connector.
2. Set the MIC/LINE switch to the LINE position.
3. Set the RECORDER TYPE switch to position B.
4. Adjust R129 to obtain a 0 dB indication on the vtvm.
5. Connect a clip lead from ground to the anode of CR3.
6. The ac vtvm should read -12.2 dB ±0.5 dB.
7. Connect a second clip lead from the anode of CR1 to ground. (Do not remove the clip lead connected in step 5.)
8. The ac vtvm should read -18.2 dB ±0.5 dB.
9. Remove the two clip leads.

NOTE

If the step 6 or step 8 reading is not correct, the resistance coupling network between the applicable oscillator output and the summing amplifier (U3) is probably defective. Refer to Section V and the schematic diagram.

COMPOSITE TEST SIGNAL END LIMIT FREQUENCY MODIFICATION

The frequency of the low and/or high frequency oscillators can be changed to meet different requirements by component value changes. The low frequency oscillator can be changed from < 10 Hz to 200 Hz; the high frequency oscillator from 3.5 kHz to 25 kHz. Frequency changes beyond these limits are not recommended due to interaction which can invalidate response and distortion tests.

The frequency of the reference oscillator can also be changed but is is not recommended because extensive design changes would be required in the remainder of the test circuits.

The Model 6500 Test Set uses Wien bridge oscillators in which the frequency of oscillation is determined primarily by the feedback components in the Wien bridge. The frequency of oscillation may be approximately predicted by the following:

(1) $$Fo = \frac{1}{2\pi RC}$$

by rearranging equation (1):

(2) $$R = \frac{1}{2\pi FC}$$

the required resistance value for a given frequency of oscillation can be determined.

In the case of the low frequency oscillator equation (2) will provide adequate results. In the case of the high frequency oscillator the results will be approximate due to stray capacity and the like, in the wiring. If the high frequency oscillator is changed the local oscillator will also have to be changed. The required resistor values will be slightly different due to the necessity of maintaining approximately 50 Hz difference frequency for proper operation of the measuring circuits.

LOCAL OSCILLATOR ADJUSTMENT

1. Connect the ac vtvm and oscilloscope to E13.
2. Set the TEST switch to the LEVEL (1) position.
3. Adjust R61 for a 1.0 volts rms indication on the vtvm. The output should be a clean sinewave with no visible distortion as observed on the oscilloscope.
4. Disconnect the vtvm and oscilloscope.

BALANCED MODULATOR ADJUSTMENT

1. Connect the digital voltmeter between TP4 (+) and TP5 (–).
2. Adjust R60 for a 100 ±5 millivolt indication on the voltmeter.
3. Disconnect the digital voltmeter.

METER AMPLIFIER ADJUSTMENT

1. Connect the signal generator to the IN connector on the test set.
2. Connect the ac vtvm to E23.
3. Set the TEST switch to the SET position.
4. Set the signal generator frequency to 1000 Hz at a nominal output level of 1.0 volts rms.
5. Adjust the REFERENCE SET control as required to produce a 32 millivolts reading on the vtvm.
6. Adjust R109 as required to bring the test set meter pointer to the center of the SET zone.
7. Set the TEST switch to REC I.
8. The meter should indicate in the SET zone.

NOTE

Steps 7 and 8 would naturally be performed as two additional steps to the reference oscillator test and alignment. Because of a requirement for meter amplifier calibration, however, the check is added to the meter calibration procedure.

RECORD OUTPUT LEVEL CALIBRATION

1. Connect the ac vtvm to the OUT connector on the test set.
2. Set the MIC/LINE switch as required.
3. Set the TEST switch to the REC I position.
4. Set the RECORDER TYPE switch as applicable.
5. To obtain desired output level adjust:

   R128 for Type A recorders.
   R129 for Type B recorders.
   R130 for Type C recorders.

NOTE

MIC and LINE outputs cannot be independently adjusted, however, different recorder types can be independently adjusted for either position.

REFERENCE SIGNAL LEVEL CALIBRATION

1. Connect the signal generator to the IN connector on the test set.
2. Set the generator frequency to 1000 Hz and the output level to a value which approximates that which will be supplied for the recorder to be tested. (A nominal value such as 1.0 volts rms can be used.)
3. Connect the ac vtvm to E16.
4. Set the TEST switch to the SET position.
5. Adjust the REFERENCE SET control on the front panel of the test set to obtain a 100 millivolt indication on the vtvm.
6. Adjust R148 (REF CAL) for a test meter indication within the SET zone.

INPUT LEVEL CALIBRATION:

1. Connect the signal generator and ac vtvm to the IN connector on the test set.
2. Set the signal generator frequency to 1000 Hz and the output to the desired level.
3. Set the TEST switch to the LEVEL (1) position.
4. Set the RECORDER TYPE switch to A, B, or C, as applicable.
5. Adjust R131, R132, or R133 to obtain a SET indication on the test set meter.

   Adjust R131 for Type A recorders.
   Adjust R132 for Type B recorders.
   Adjust R133 for Type C recorders.

REFERENCE SET CONTROL RANGE TEST:

1. Connect the signal generator and ac vtvm to the IN connector on the test set.
2. Set the TEST switch to the SET position.
3. Set the signal generator output to 90 millivolts rms at 1000 Hz.
4. Adjust the REFERENCE SET control to obtain a SET indication on the test set meter.
5. Set the signal generator output to 1.1 volts rms at 1000 Hz.
6. Adjust the REFERENCE SET control to obtain a SET zone indication on the test set meter.

NOTE

The REFERENCE SET control range test verifies sufficient adjustment range for the control. If the range is not acceptable the reference signal level calibration is not correct or the control (potentiometer) is probably defective. Refer to Section V and to the schematic diagram.

LOW FREQUENCY LEVEL ADJUSTMENT:

1. Connect the OUT connector to the IN connector using a jumper cable.
2. Set the TEST switch to the SET position.
3. Adjust the REFERENCE SET control to obtain a SET zone indication on the test set meter.
4. Set the TEST switch to the LOW F (1) position.
5. Adjust R149 for a SET zone indication on the test set meter.

HIGH FREQUENCY LEVEL ADJUSTMENT:

1. Repeat steps 1 through 4 of LOW FREQUENCY LEVEL ADJUSTMENT.
2. Set the TEST switch to the HI F (1) position.
3. Set the RECORDER TYPE switch to position B.
4. Adjust R150 for a SET zone indication on the test set meter.

DISTORTION CALIBRATION:

1. Connect the signal generator and ac vtvm to the IN connector on the test set.
2. Set the signal generator frequency to 1000 Hz and adjust the output level to 100 millivolts rms.
3. Set the TEST switch to the SET position.
4. Adjust the REFERENCE SET control for a SET zone indication on the test set meter.
5. Set the TEST switch to the DIST (2) position.
6. Set the signal generator output level to the rms millivolt level which corresponds to the desired distortion percentage (i.e., 3 millivolts rms is equivalent to 3% distortion, 1.5 millivolts rms, to 1.5% distortion, etc).
7. Set the generator to 3000 Hz, then adjust R151, R152, or R153 to cause the test set meter to indicate in the SET zone.

   Adjust R151 for Type A recorders.
   Adjust R152 for Type B recorders.
   Adjust R153 for Type C recorders.

FLUTTER CALIBRATION:

1. Connect the voltage controlled oscillator, frequency counter and ac vtvm to the IN connector on the test set.
2. Set the oscillator center frequency to 1000 Hz and adjust the output level for a zero dB indication on the vtvm.
3. Set the TEST switch to the SET position.
4. Adjust the REFERENCE SET control to obtain a SET indication on the test set meter.
5. Modulate the voltage controlled oscillator with a 20 Hz signal of sufficient amplitude to simulate the desired flutter value.
6. Set the TEST switch to FLUT (2).
7. Adjust R154, R155, or R156 to cause the test set meter to indicate in the SET zone.

   Adjust R154 for Type A recorders. (1)
   Adjust R155 for Type B recorders. (.3)
   Adjust R156 for Type C recorders. (.1)

SIGNAL-TO-NOISE RATIO CALIBRATION:

1. Connect the signal generator and ac vtvm to the IN connector on the test set.
2. Set the signal generator frequency to 1000 Hz and adjust the output level for a zero dB indication on the vtvm.
3. Set the TEST switch to the LEVEL II position.
4. Adjust the REFERENCE SET control to obtain a SET zone indication on the test set meter.
5. Reduce the output of the signal generator by the desired signal-to-noise ratio (i.e., if 20 dB is desired, reduce level by 20 dB).

SIGNAL-TO-NOISE RATIO CALIBRATION (Cont.):

6. Set TEST switch in the SNR position.
7. Adjust R145, R146, or R147 to cause the test set meter to indicate in the SET zone.

   Adjust R145 for Type A recorders.
   Adjust R146 for Type B recorders.
   Adjust R147 for Type C recorders.

SELF TEST FUNCTION – TEST AND ADJUSTMENT

The BATT, REC I, and REC II positions of the TEST switch do not initiate test functions. The BATT and REC II positions are tied to the positive power supply and the REC I position monitors a portion of the reference oscillator output.

1. Place TEST switch in BATT position and depress the SELF TEST switch. The test set meter shall indicate above the BATT OK line.
2. Place TEST switch in REC I position and depress the SELF TEST switch. The test set meter shall indicate in the SET zone.
3. Place TEST switch in the REC II position and depress the SELF TEST switch. The test set meter shall indicate above the BATT OK line.
4. Connect the ac vtvm between E36 and ground.
5. Place TEST switch in LEVEL (1) position.
6. Depress and hold the SELF TEST switch.
7. Adjust R36 to obtain SET zone meter indication (35 millivolts indication on the ac vtvm).
8. Move the TEST switch to the SET position. The test set meter reading should stay in the SET zone.
9. Move the TEST switch to the LO F position. The test set meter reading should stay in the SET zone.
10. Move the TEST switch to the HI F position. The test set meter reading should stay in the SET zone.
11. Move the TEST switch to the DIST position. The test set meter reading should stay in the SET zone.
12. Move the TEST switch to the FLUT position.
13. Adjust R104 for a SET zone indication on the test set meter.
14. Move the TEST switch to the LEVEL II position. The test set meter should indicate in the SET zone.
15. Move the TEST switch to the SNR position. The test set meter should indicate in the SET zone.
16. Test and calibration is complete. Move the TEST switch to the OFF position, turn off power, and replace the top cover.

MODEL 6500 RECORDER TYPE OR TEST PARAMETER CALIBRATION

The preceding alignment, calibration, and test procedures cover a complete sequence for the Model 6500 Recorder Test Set. The complete series of procedures are not required to calibrate the test set for use in testing a specific recorder or in changing the acceptable limit of a performance characteristic. Those procedures specifically identified as calibration procedures accomplish this task. These procedures can be performed separately as required. The following is a list of the calibration procedures:

RECORD OUTPUT LEVEL CALIBRATION
REFERENCE SIGNAL LEVEL CALIBRATION
INPUT LEVEL CALIBRATION
DISTORTION CALIBRATION
FLUTTER CALIBRATION
SIGNAL-TO-NOISE RATIO CALIBRATION

TROUBLESHOOTING

The Model 6500 Recorder Test Set incorporates a self-test feature. If instrument operation is suspect, disconnect all signal leads, depress and hold the SELF TEST switch, then switch through each position of the TEST switch. If the unit is functioning correctly, the meter will indicate in the SET zone for all test positions except the BATT and REC II positions. In these positions the meter must indicate above the BATT OK line.

NOTE

The BATT, REC I, and REC II checks can be made without depressing the SELF TEST switch.

If the self-test check confirms improper performance, the self-check capability can be used to localize the problem area. The troubleshooting procedure outlined below accomplishes this task. The troubleshooting procedure must be performed in the sequence presented.

TROUBLESHOOTING PROCEDURE

TEST: BATT
SYMPTOM: Meter indication is below BATT OK line.
PROBLEM: Power Supply or dc meter circuit defective.
ACTION: Perform POWER TEST procedure.

If power supply is defective:

1. For dc power pack, replace batteries.
2. For AC power pack:
   a. Check source power and verify line voltage is correct and that the line voltage select switch is in correct position.
   b. Check test unit fuse.
   c. Check POWER switch.
   d. Check for defective components. See Section V and schematic diagram.

If dc meter circuit is defective:

1. Check meter for continuity.
2. Check for defective components. See Section V and schematic diagram.

TEST: REC I
SYMPTOM: Meter does not indicate in SET zone.
PROBLEM: Reference oscillator is defective, resistive divider (R21-R22) is defective, meter amplifier is defective, or circuit continuity is interrupted.
ACTION: Perform REFERENCE OSCILLATOR test.

1. If oscillator is not operating, refer to Section V and to schematic diagram.
2. If oscillator is ok, check resistive divider R21 and R22.
3. Use schematic diagram to check continuity from R21/R22 to C53 (+).
4. If meter amplifier is defective, refer to Section V and to schematic diagram.
5. Use schematic diagram to check continuity from C55 (–) to anode/cathode connection of CR10 and CR12.

TEST: REC II (Duplicates BATT check.)

TEST: LOW FREQ (Press and hold SELF TEST switch.)
SYMPTOM: Meter does not indicate in SET zone.
PROBLEM: Low frequency oscillator, summing amplifier, input amplifier or low pass filter is defective.
ACTION: Perform LOW FREQUENCY OSCILLATOR test.

1. If oscillator is not operating, refer to Section V and the schematic diagram.
2. If oscillator is ok, perform steps 1, 2, 5, 7, 8 and 9 of the COMPONENT LEVEL VERIFICATION (COMPOSITE SIGNAL). If check is not acceptable, refer to summing amplifier discussion in Section V and to the schematic diagram.
3. If summing amplifier output is correct, check for signal at E16 (see figure 4-1). If signal is not present,refer to input signal conditioning discussion in Section V and to the schematic diagram.
4. If signal is present at E16, refer to the low pass filter discussion in Section V and to the schematic diagram.

TEST: FLUT (Press and hold SELF TEST switch.)
SYMPTOM: Meter does not indicate in SET zone.
PROBLEM: Bandpass filter, flutter demodulator, or 4.0 Hz multivibrator is defective.
ACTION: Use an oscilloscope to trace the signal (1000 Hz after filtering) through the bandpass filter (U6 pin 6 and U8 pin 6 on schematic diagram).

1. If signal is interrupted,refer to Section V and to the schematic diagram.
2. If bandpass filter is functional, check 4.0 Hz (nominal) free running multivibrator for presence of simulated flutter signal (collector of Q15 on schematic diagram).
3. If simulated flutter signal is present, flutter demodulator is defective. Refer to Section V and to the schematic diagram.

TEST: SNR (Press and hold SELF TEST switch.)
SYMPTOM: Meter does not indicate in SET zone.
PROBLEM: Signal-to-noise amplifier is defective or signal continuity is interrupted.
ACTION: Use an oscilloscope and the schematic diagram to track the test signal from E16 through the signal-to-noise amplifier to the + side of C53.

1. If the amplifier is defective, refer to Section V and to the schematic diagram.

NOTE

In the SELF TEST condition the gain of the amplifier is fixed. If the meter indication is present but not in the SET zone, the amplifier gain has probably shifted.

TEST: LEVEL (1) (Press and hold SELF TEST switch.)
SYMPTOM: Meter does not indicate in SET zone.
PROBLEM: Local oscillator or balanced modulator is defective.
ACTION: Perform LOCAL OSCILLATOR ADJUSTMENT.

1. If local oscillator is defective, refer to Section V and to the schematic diagram.
2. If local oscillator is functioning normally, the balanced modulator is defective. Refer to Section V and to the schematic diagram.

TEST: HI F (Duplicates LEVEL (1) test.)

TEST: SET (Duplicates LEVEL (1) test.)

TEST: LEVEL II (Duplicates LEVEL (1) test.)

TEST: DIST (Press and hold SELF TEST switch.)
SYMPTOM: Meter does not indicate in SET zone.
PROBLEM: In the DIST, SELF TEST condition the meter is driven by a dc voltage from the balanced modulator. If the meter does not indicate,a circuit discontinuity is present. See the schematic diagram.

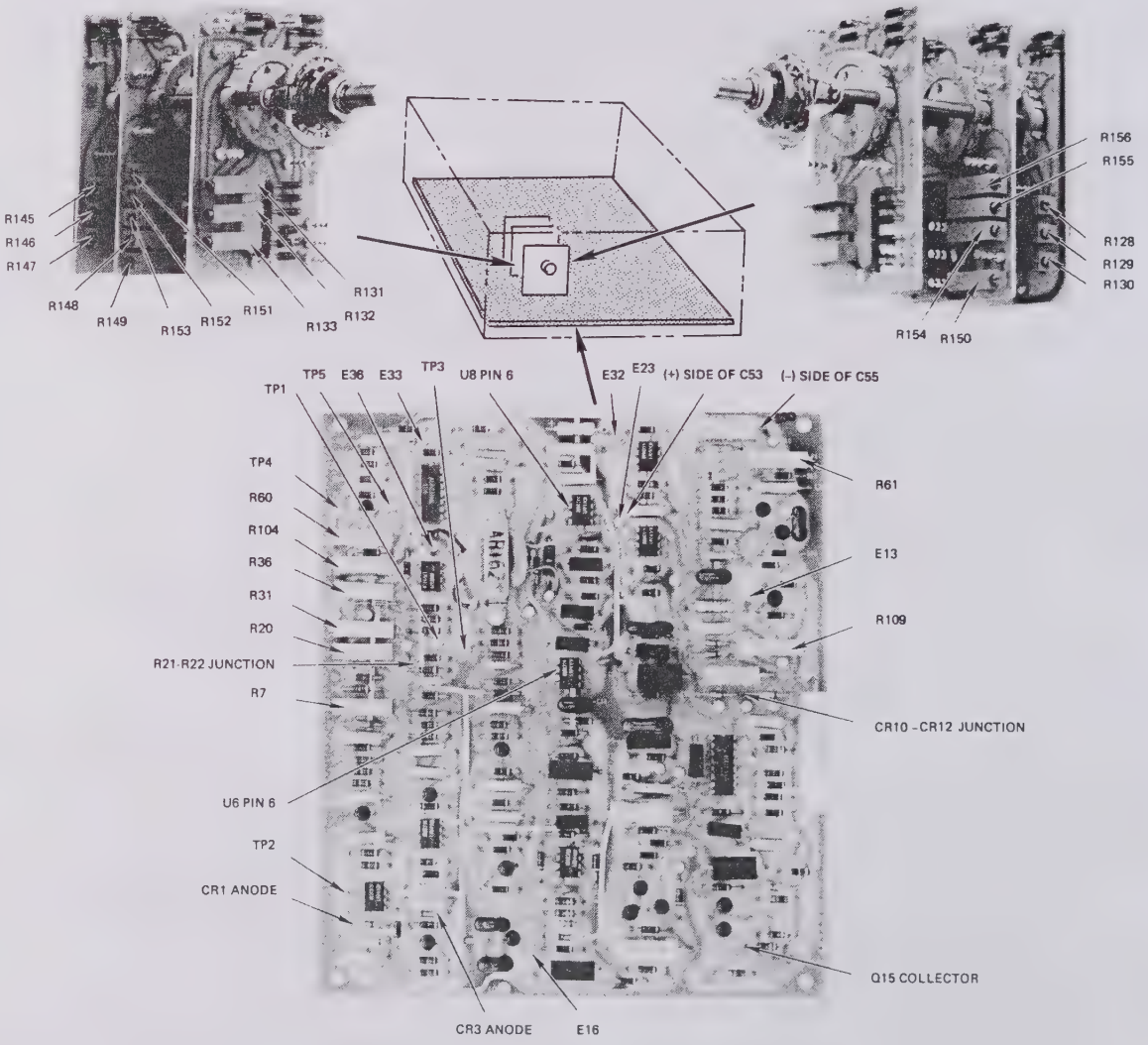


Figure 4-1. Adjustment and Test Point Location

SECTION V
FUNCTIONAL DESCRIPTION

GENERAL

The Model 6500 Recorder Test Set circuitry can be divided into seven functional areas. These areas are: signal generation and output conditioning, input signal conditioning, active filtering, flutter demodulation, distortion demodulation, noise amplification, and metering.

All active electronics, except power supply circuitry, are contained on a common printed circuit board assembly. Some calibration potentiometers and other passive components are mounted on the switch assemblies.

Figure 5-1 is a block diagram of the Model 6500 Test Set. The dashed line connections shown on the diagram are made only when the TEST switch is in the indicated position.

SIGNAL GENERATION AND OUTPUT CONDITIONING

The Model 6500 Recorder Test Set supplies a three-element composite test signal. The test signal is available at a nominal output level or at one suitable for microphone inputs. The test signal elements are: high and low band edge frequencies and reference frequency. The high and low band edge frequency levels are supplied below the reference frequency level to permit maximum record drive without high frequency saturation of the tape. Separate oscillators are used to generate each element of the composite signal. The oscillators are of the Wien bridge configuration and use FET stabilization. The low and reference frequency oscillators are identical except for frequency determining components. The high frequency oscillator is a discrete design due to phase shift in the operational IC amplifiers. The high and low frequency oscillator frequencies are changed for each recorder type. This is accomplished through the RECORDER TYPE selection switch.

The outputs of the oscillators are connected to the input of a summing amplifier. In the instance of the high and low frequency oscillators, the connection is through attenuator pads which give an 18 and 12 dB reduction in output signal level. The output of the summing amplifier is coupled to the OUT connector of the unit through an isolation transformer to eliminate the ground reference.

LOW FREQUENCY OSCILLATOR. The low frequency oscillator (see figure 5-2) operates at one of three frequencies. In the standard unit these frequencies are 50 Hz, 100 Hz, and 200 Hz.[1] Frequency shifts are accomplished by changing the resistive elements of the oscillator bridge through the RECORDER TYPE selector switch. Resistors R116 and R119 determine the frequency for Type A recorders (200 Hz), R117 and R120, for Type B recorders (100 Hz), and R118 and R121, for Type C recorders (50 Hz). The output level from the oscillator (TP2) is controlled by output level set potentiometer R7. The oscillator operates in all TEST switch positions except REC II, LEVEL II, and SNR. When the switch is in one of these positions, a ground is applied to the base of a gating transistor (Q2) which, in turn, applies a negative bias to U1 (low frequency oscillator) through isolation diode CR1. The negative bias inhibits the oscillator.

REFERENCE FREQUENCY OSCILLATOR. The reference frequency oscillator (see figure 5-3) operates at a single frequency of 1000 Hz. The reference frequency is identical for all recorder types. Resistive components determining frequency are R13 and R41. The reference frequency cannot be changed without extensive design changes in the circuitry of the test set. The output level from the reference oscillator (TP1) is controlled by output level control potentiometer R20. As is the case with the low frequency oscillator, the reference oscillator is functional in all TEST switch positions except REC II, LEVEL II, and SNR. In these positions, the oscillator is biased off by means of the negative bias from Q2 which is applied through CR3.

[1] Within limits, these frequencies can be varied for special requirements. See the Maintenance section for information regarding frequency changes in the low and high frequency oscillators.

HIGH FREQUENCY OSCILLATOR. The high frequency oscillator (see figure 5-4) operates at one of three frequencies. In the standard unit these frequencies are 4.0 kHz, 8.0 kHz, and 16 kHz.[2] Frequency shifts are accomplished by changing the resistive elements of the oscillator bridge through the RECORDER TYPE switch. Resistors R122 and R125 determine the frequency for Type A recorders (4.0 kHz), R123 and R126, for Type B recorders (8.0 kHz) and R124 and R127, for Type C recorders (16 kHz). The output level from the oscillator (TP3) is controlled by output level set potentiometer R31. The high frequency oscillator is functional in all TEST switch positions except REC II, LEVEL II and SNR. The negative bias which inhibits the oscillator in these positions is from gate Q2 and is applied through CR4.

SUMMING AMPLIFIER. The summing amplifier (see figure 5-5) accepts the three outputs from the composite signal oscillators. (The outputs from the high and low frequency oscillators are reduced 18 and 12 dB, respectively, before application to the summing amplifier input.) The gain of the summing amplifier and, therefore, the output level, is a function of the amount of negative feedback employed. The feedback, in turn, is a function of potentiometer R128, R129, or R130. The effective potentiometer is determined by the position of the RECORDER TYPE selector switch. The use of a different potentiometer for each recorder type permits the output level to be independently calibrated for each type.

One additional feedback path (through R36) exists when the SELF TEST switch is closed. This path permits the output signal level to be optimized for the self-check function.

The summing amplifier output is connected to the primary of isolation transformer T1. The transformer provides an output signal which is isolated from ground. A resistive divider network is connected across the secondary winding. The divider provides a second output which is 60 dB below normal level for microphone operation. A single pole double throw slide switch permits either output to be routed to the test set output connector.

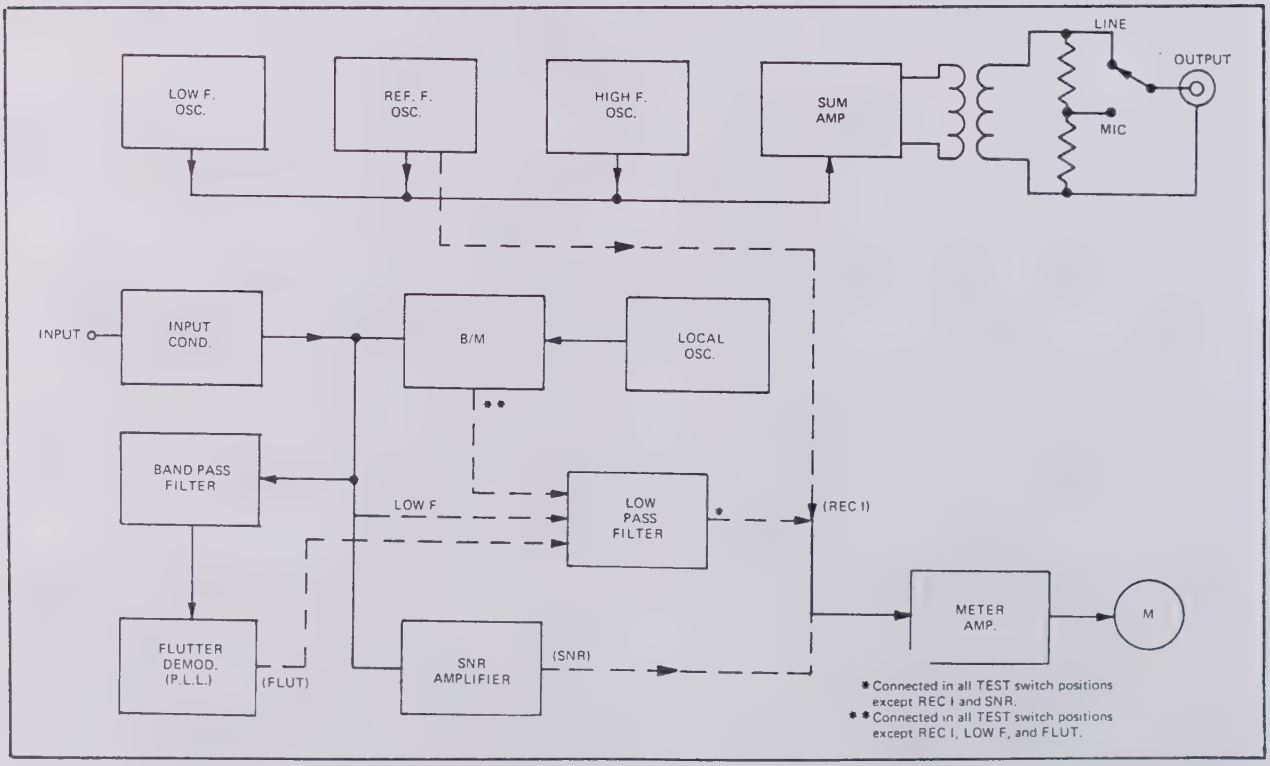


Figure 5-1. Model 6500 Test Set, Block Diagram

[2] Within limits, these frequencies can be varied for special requirements. See the Maintenance section for information regarding frequency changes in the low and high frequency oscillators.

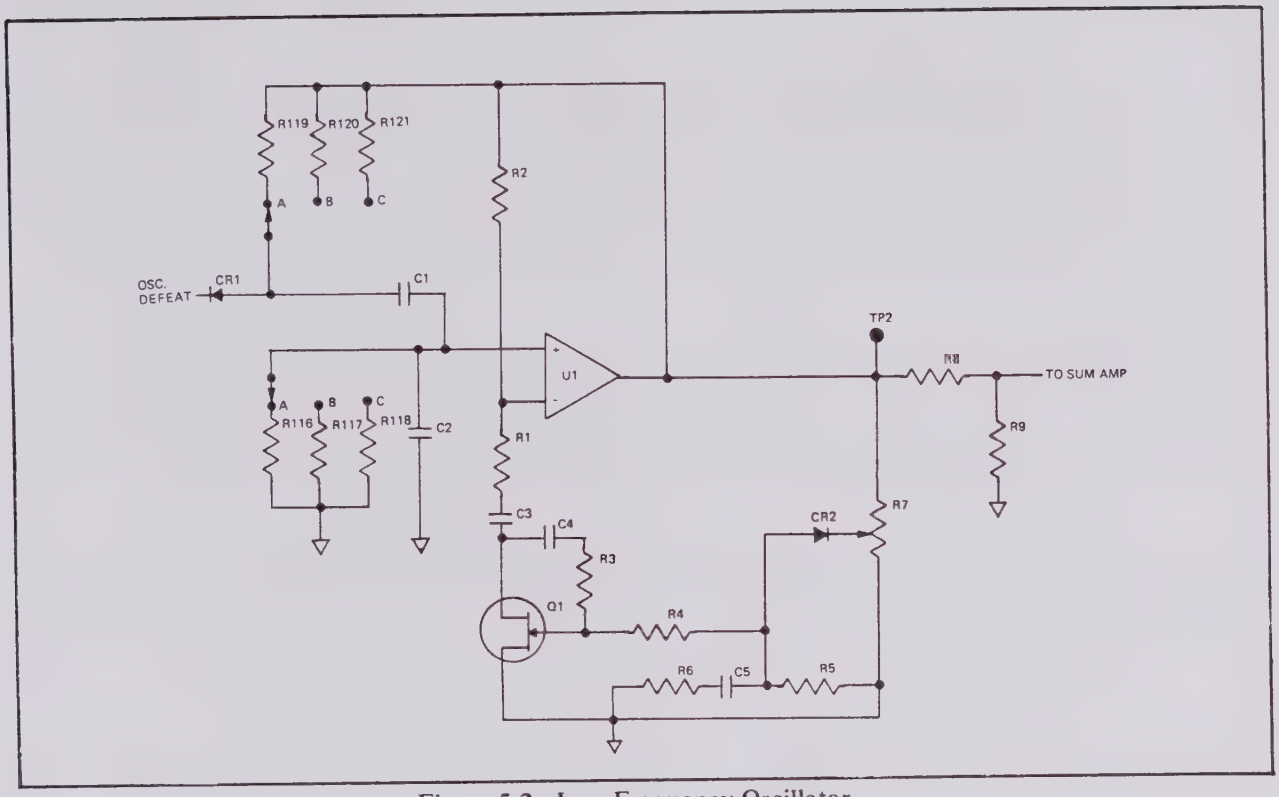


Figure 5-2. Low Frequency Oscillator

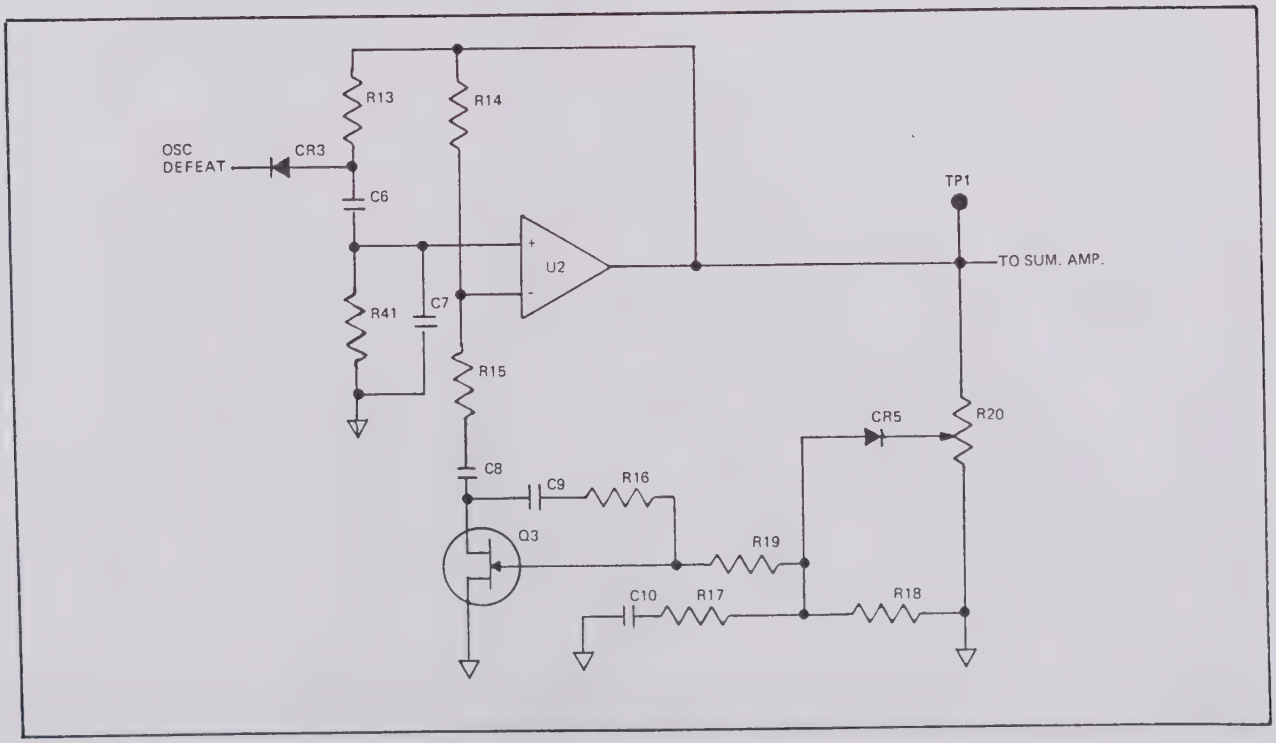


Figure 5-3. Reference Oscillator

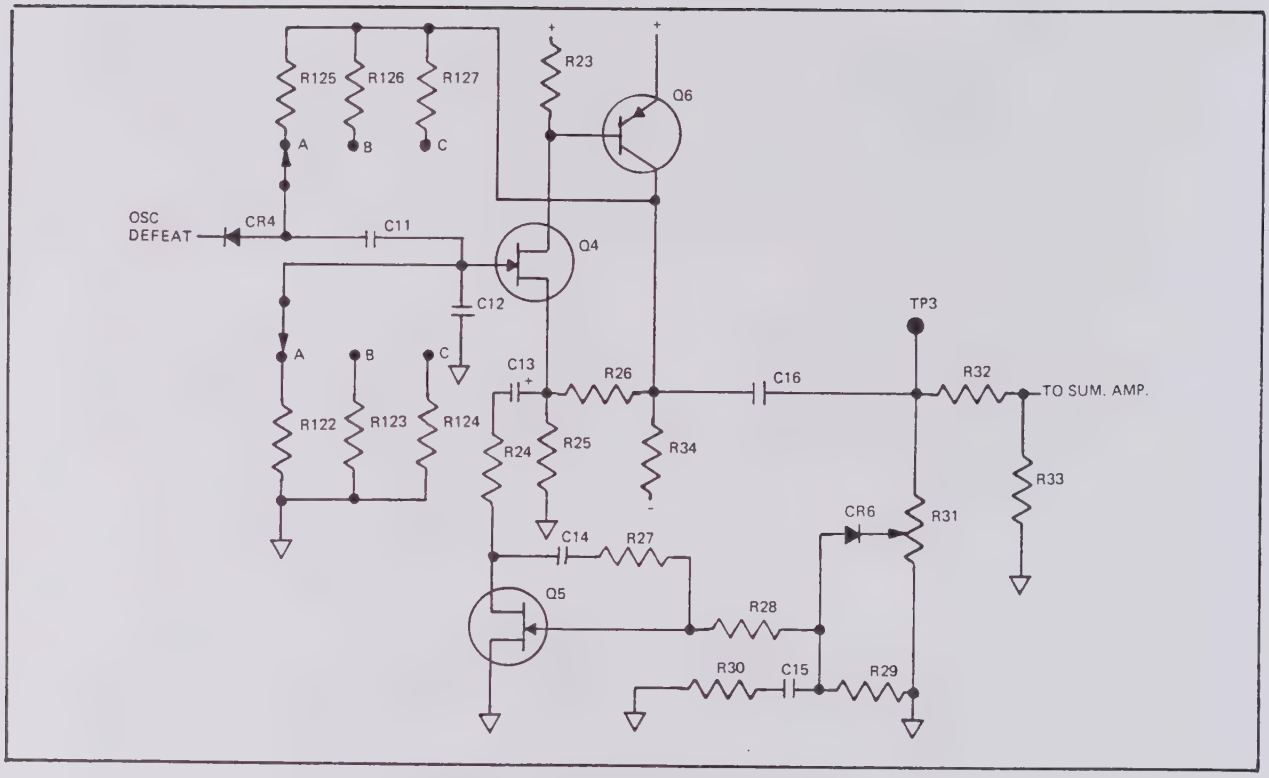


Figure 5-4. High Frequency Oscillator

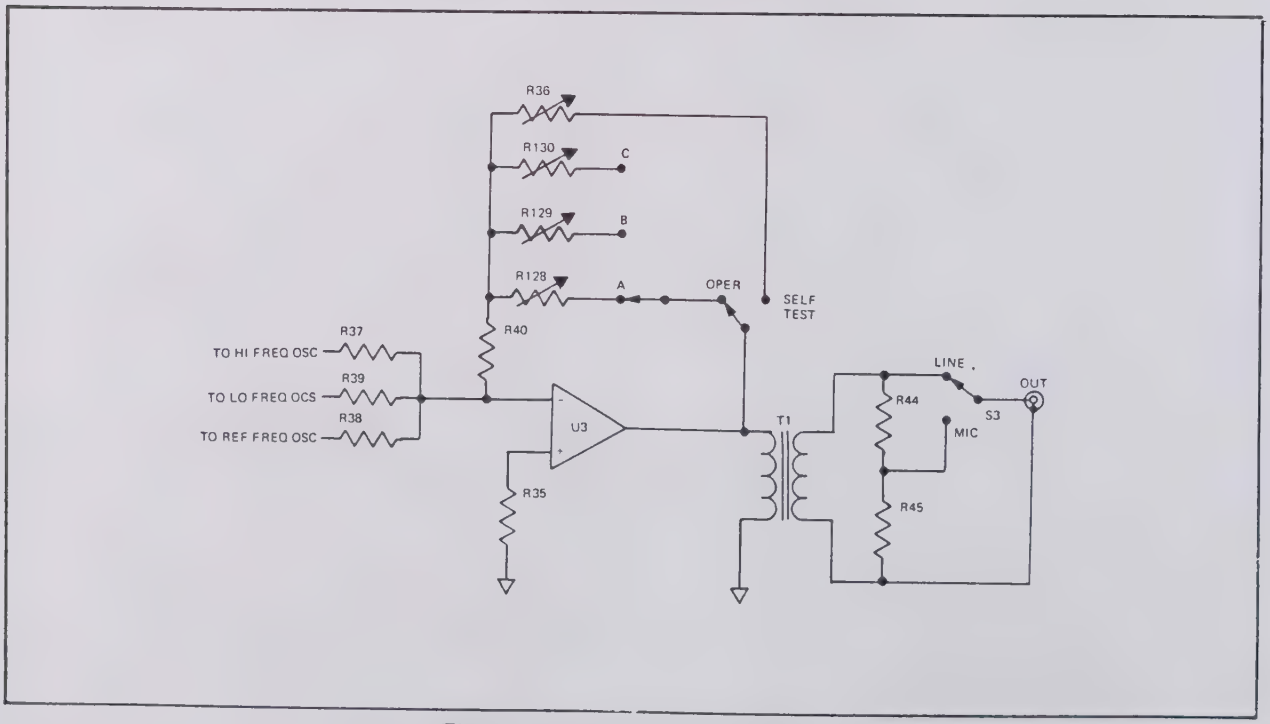


Figure 5-5. Summing Amplifier

INPUT SIGNAL CONDITIONING

The signal applied to the IN connector of the test set is applied across the REFERENCE SET potentiometer (front panel control) in all positions of the TEST switch except the LEVEL (1) position (see figure 5-6). In the LEVEL (1) position, one of three calibration potentiometers (R131, R132, or R133) is substituted for the REFERENCE SET potentiometer. The effective potentiometer is a function of the RECORDER TYPE selection switch position. Use of separate calibration potentiometers for each recorder type permits the input signal level to be independently calibrated for each type. Input level calibration is required to allow the test set operator to confirm the input is within ±3 dB of the desired level. The REFERENCE SET control (R159) is used to normalize the input signal level to the test set.

The signal present at the wiper of the REFERENCE SET control (or from the wiper of the effective calibration potentiometer in the LEVEL (1) position) is routed to input amplifier U4. The input to U4 is diode protected to prevent damage in the event of excess input signal level. Resistor R46, in series with the diodes, provides current limiting protection for the diodes. The normalized signal output from amplifier U4 is routed to a balanced modulator (used for reference, distortion, and high frequency tests), a signal-to-noise amplifier, an active bandpass filter and to a low pass filter selection switch.

When the self-test capability is enabled by pressing the SELF TEST switch, the composite signal generated within the test set is applied to the input of U4 in place of the external input. The function of the test set is identical except that it is, of course, confirming its own operation.

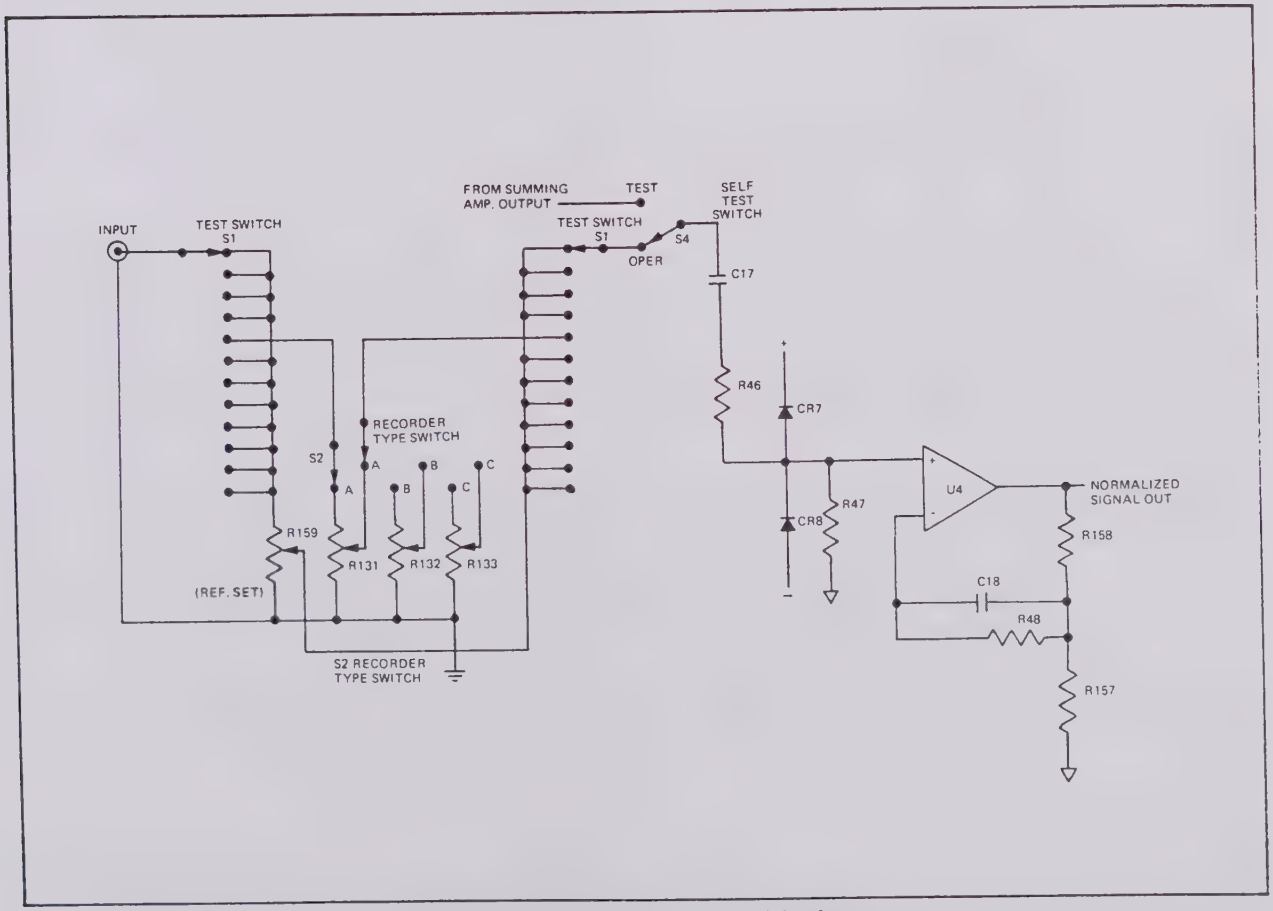


Figure 5-6. Input Signal Conditioning

LOCAL OSCILLATOR AND BALANCED MODULATOR. The balanced modulator (see figure 5-7) is used when measuring LEVEL (1), SET, LEVEL II, DIST (distortion), or HI FREQ (high frequency). The balanced modulator accepts inputs from the input amplifier (U4) and a local oscillator (Q8, Q9, and Q10). The oscillator provides the switching input required by the balanced modulator. The local oscillator is a Wien bridge oscillator identical to the high frequency oscillator except for frequency determining components. It operates at 50 Hz less than the signal to be measured. The operating frequency is determined automatically through the RECORDER TYPE and TEST switches settings. The difference between the switching frequency and the test frequency produces a 50 Hz signal that has an amplitude proportional to the test frequency. The signal at the output of the modulator is routed to a low pass filter input selector switch.

LOW PASS FILTER. The low pass filter (see figure 5-8) accepts inputs from the balanced modulator, the flutter demodulator, and the input amplifier. The applicable input for a given performance test is established through the TEST switch position. The filter eliminates (or minimizes) all higher frequency components and provides a clean sine wave to the meter amplifier. It is a 0.5 dB, three pole, Chebyshev filter. The gain of the filter amplifier is variable by means of feedback resistance selected through the RECORDER TYPE and TEST switches. Instrument calibration for the composite signal components, flutter distortion, and self test functions are accomplished in the low pass filter feedback network.

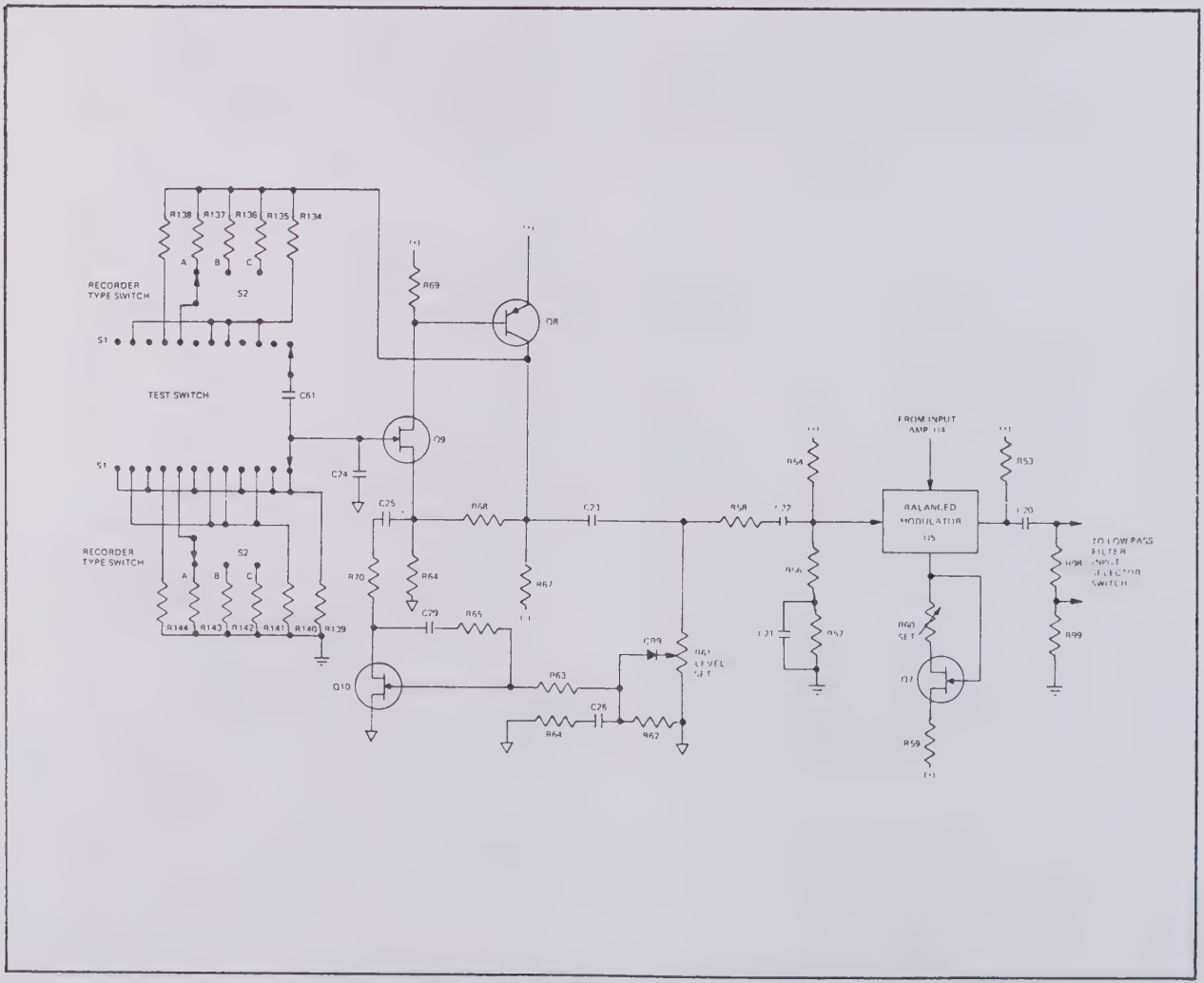


Figure 5-7. Local Oscillator and Balanced Modulator

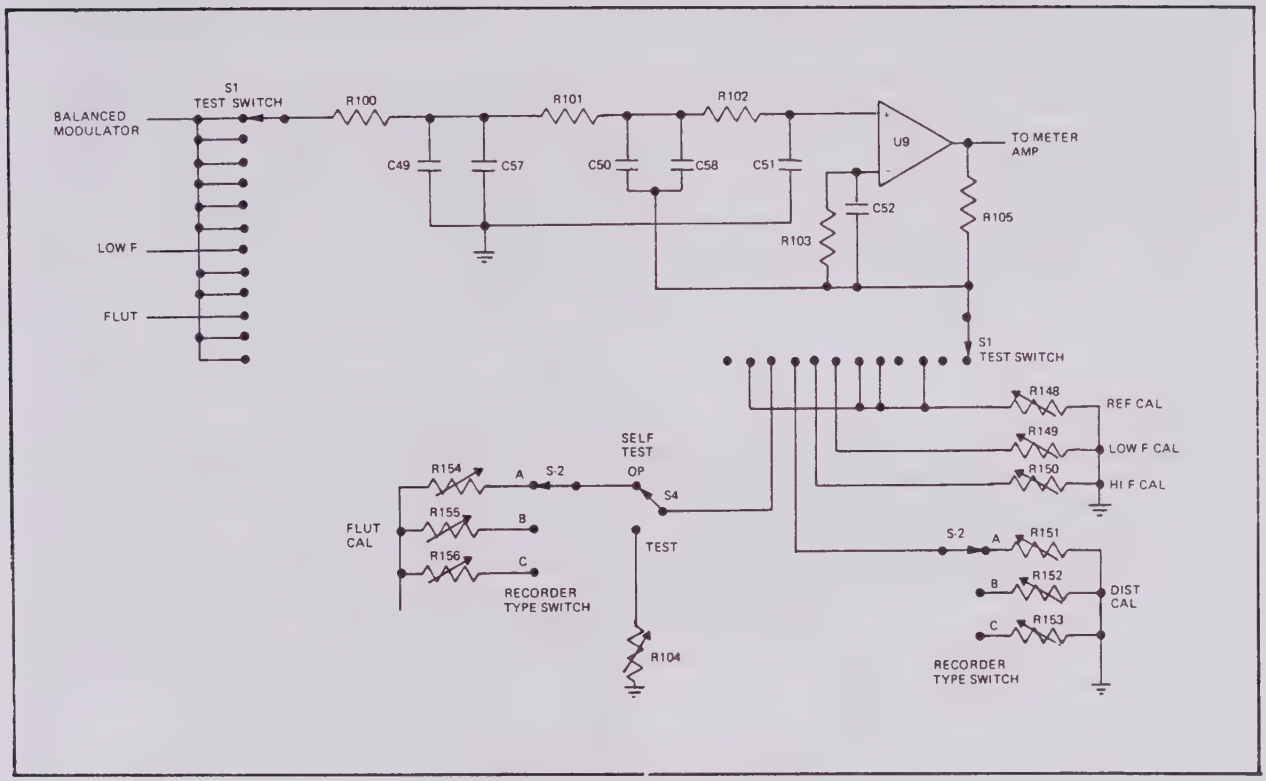


Figure 5-8. Low Pass Filter

DISTORTION ANALYZER. Distortion measurements are made using the balanced modulator, the local oscillator, and the low pass filter. The reproduced signal is applied to one input of the balanced modulator and a 3.05 kHz signal (the third harmonic of the reference frequency plus a 50 Hz offset) from the local oscillator is applied to another. The output from the modulator is routed through the low pass filter to remove the sum and other carrier products. The result is a 50 Hz difference signal with an amplitude directly proportional to the 3.0 kHz content (3rd harmonic) of the reproduced signal from the recorder under test. The 50 Hz signal is routed to the meter circuits for presentation on the test set meter.

FLUTTER DEMODULATOR. The flutter demodulator circuit (see figure 5-9) consists of a bandpass filter and an integrated circuit demodulator. The filter (U6 and U8) removes the high and low frequency component of the composite signal leaving only the reference frequency to be routed to the "Phase Locked Loop" demodulator (U7). The demodulator detects frequency variations in the reference signal (flutter) and supplies this error signal to an R-C filter which provides some response shaping. The R-C filter output is routed to the low pass filter and, in the FLUT position of the test switch, to the meter circuit for display.

Transistors Q14 and Q15 form a low current, free running multivibrator which operates at approximately 4 Hz. When the SELF TEST switch is actuated, this signal is fed into the demodulator as a flutter signal to confirm correct operation of the flutter test capability.

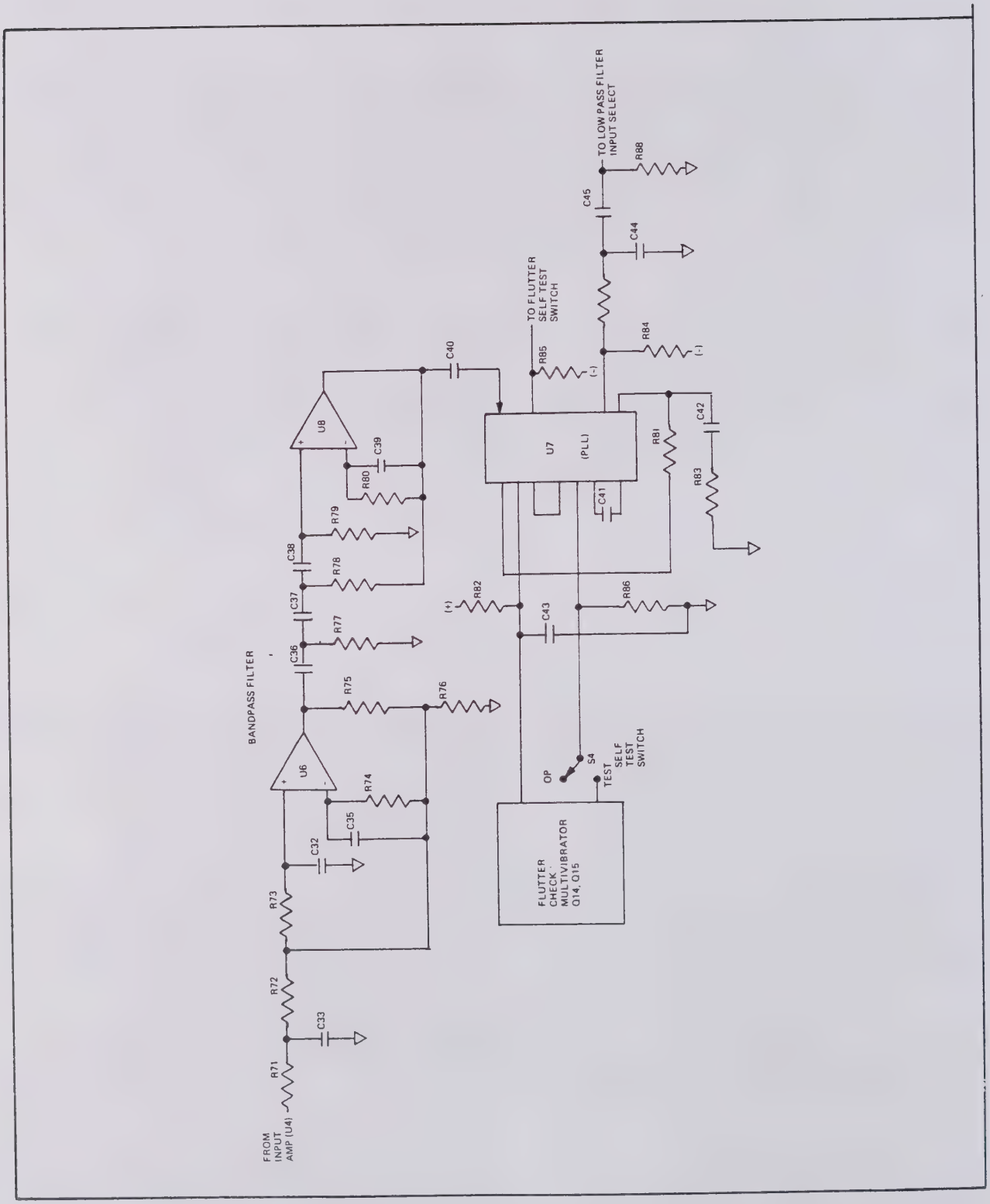


Figure 5-9. Flutter Demodulator

NOISE AMPLIFIER

The noise amplifier (see figure 5-10) is a high gain, low noise, feedback stabilized pair (Q12 and Q13). Transistor Q13 is an active constant current source collector load for Q12. The purpose of a constant current source load is to maintain good gain and bandwidth stability over a 30% variation in power supply voltage. The gain of the amplifier is determined by resistor R145, R146, or R147. The effective potentiometer is a function of the RECORDER TYPE switch position. Three potentiometers permit a separate signal-to-noise ratio calibration for each recorder type. The output of the noise amplifier is connected to the meter amplifier when the TEST switch is in the SNR position. When the SELF TEST switch is closed, the calibration potentiometers are bypassed to increase the gain of the amplifier (to achieve a center scale meter reading).

METER AMPLIFIER

The meter amplifier (see figure 5-11) is an average responding, rms calibrated circuit. The 3 dB bandwidth of the circuit is typically from 0.3 Hz to 70 kHz. The meter is highly damped to provide ease of reading at the low frequencies encountered during some flutter measurements. Potentiometer R109 controls the gain of meter amplifier U10. Except in TEST switch positions OFF, BATT, and REC II, the meter directly monitors the bridge rectified output of U10. In the OFF position of the TEST switch, both meter terminals are tied to the negative power supply; in BATT and REC II positions the meter is connected between the plus and minus supplies. The LEVEL II position is interlocked through the self-test switch. When the switch is depressed to initiate the self-test capability, the meter is connected between the plus and minus supplies as is the case in the BATT and REC II positions.

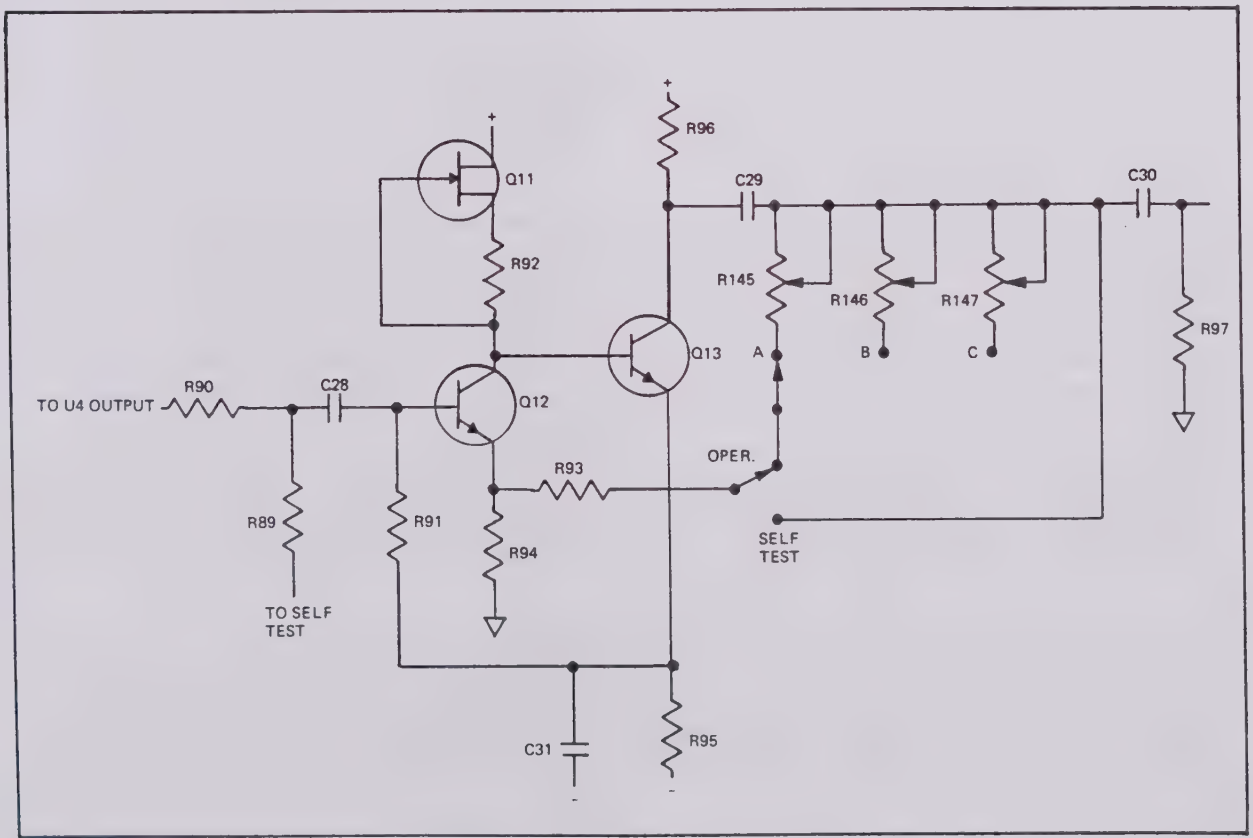


Figure 5-10. Signal-to-Noise Amplifier

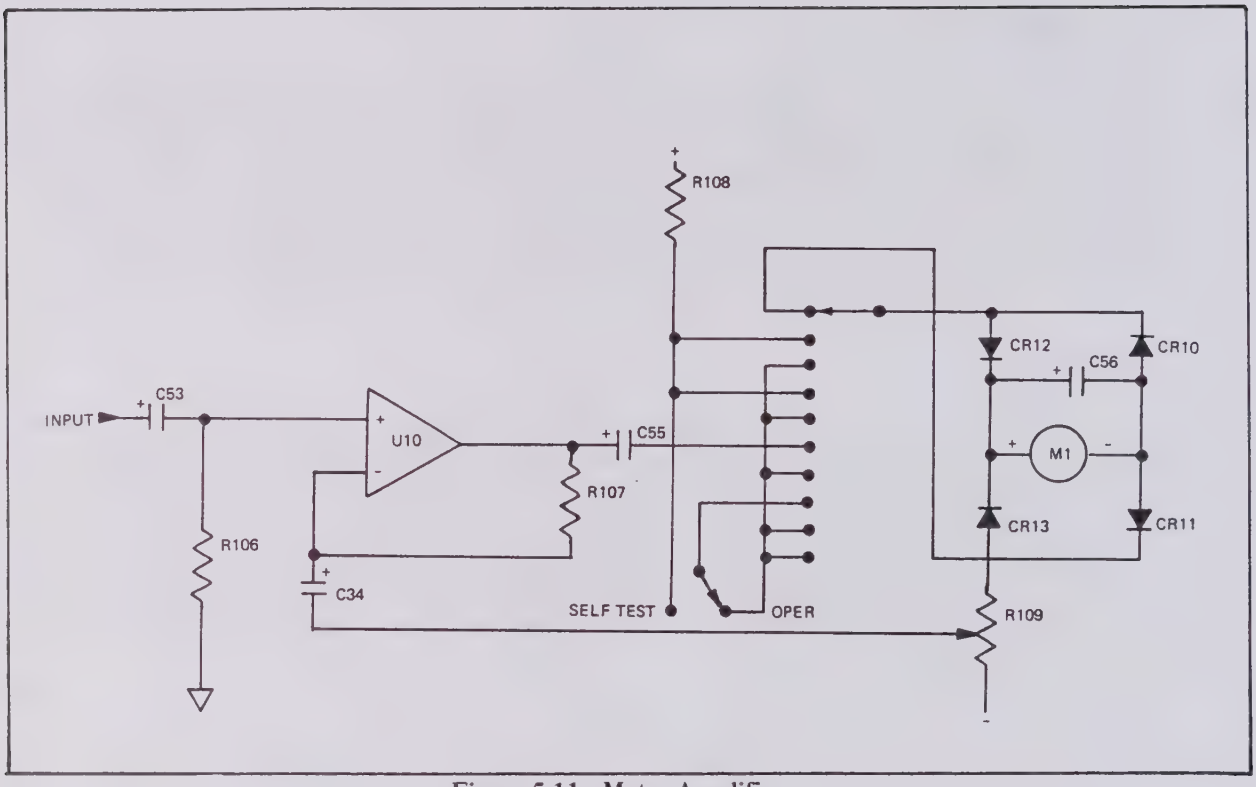


Figure 5-11. Meter Amplifier

AC POWER PACK (PANEL)

The ac power pack (see inset on schematic diagram) provides ±4.0 volts regulated dc. The negative power supply automatically tracks the positive supply to insure equal positive and negative voltage levels. The power supply consists of a power transformer with center tapped primary and secondary windings, diodes for full wave rectification, zener reference diodes, differential error amplifiers, and series regulating transistors. Line power is routed through a 115/230 volt power source selector switch which determines whether voltage is applied across half the primary winding (115 volt operation) or across the full winding (230 volt operation). When the power switch on the front panel of the test unit is closed, voltage is applied to the winding.

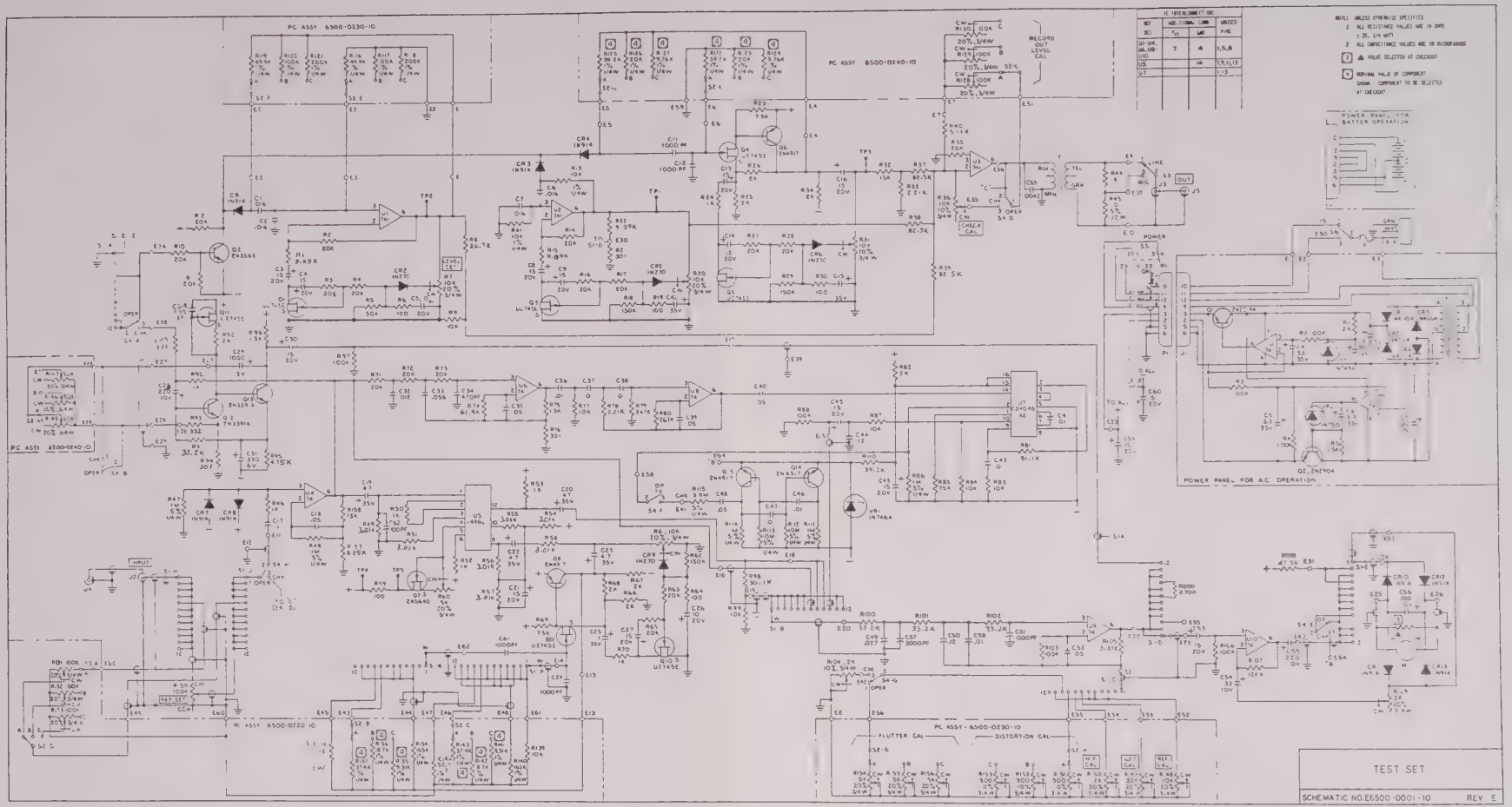
The center tap of the secondary winding is the common reference between the plus and minus supplies. The positive portion of the power supply assembly is a conventional regulated supply. The unregulated dc voltage is obtained by full wave rectification. The unregulated dc is applied to a reference voltage divider (where the reference element is a zener diode) and to a series regulating transistor. The series regulator is controlled from a differential error amplifier which compares the output voltage level to the reference voltage present across the zener diode to produce the control voltage.

The negative portion of the power supply assembly is similar to the positive supply, however, the differential error amplifier operates between the negative and positive supply voltages. One input to the amplifier is the common reference between the two supplies (centertap of secondary winding). The second input is the difference between the two regulated output voltages. The net result is the differential amplifier causes the negative supply to track the positive supply. The two outputs are thus always of equal amplitude although the actual dc level may shift.

SECTION VI
SCHEMATICS

GENERAL

Drawing E6500-0001-10 is a composite schematic for the Model 6500 Recorder Test Set supplied to support maintenance and use of the unit.


PC ASSY 6500-0230-10
PC ASSY 6500-0240-10
PC ASSY 6500-0220-10
PC ASSY 6500-0240-10
PC ASSY - 6500-0230-10
FLUTTER CAL
DISTORTION CAL
RECORD OUT LEVEL CAL
POWER PANEL FOR A.C OPERATION
TEST SET
SCHEMATIC NO.E6500-0001-10
REV E

SECTION VII
PARTS LISTS

GENERAL

The parts lists given in the following pages contains information needed for ordering replacement parts.

ORDERING REPLACEMENT PARTS

Parts for this equipment should be ordered through Data Check Corporation. Prices and delivery information on parts or complete instruments may be obtained from the Data Check Sales Department. It is recommended that whenever possible, and particularly when an instrument is used in a critical application, the user maintain a minimum stock of spare parts.

When ordering parts, the following information should always be supplied:

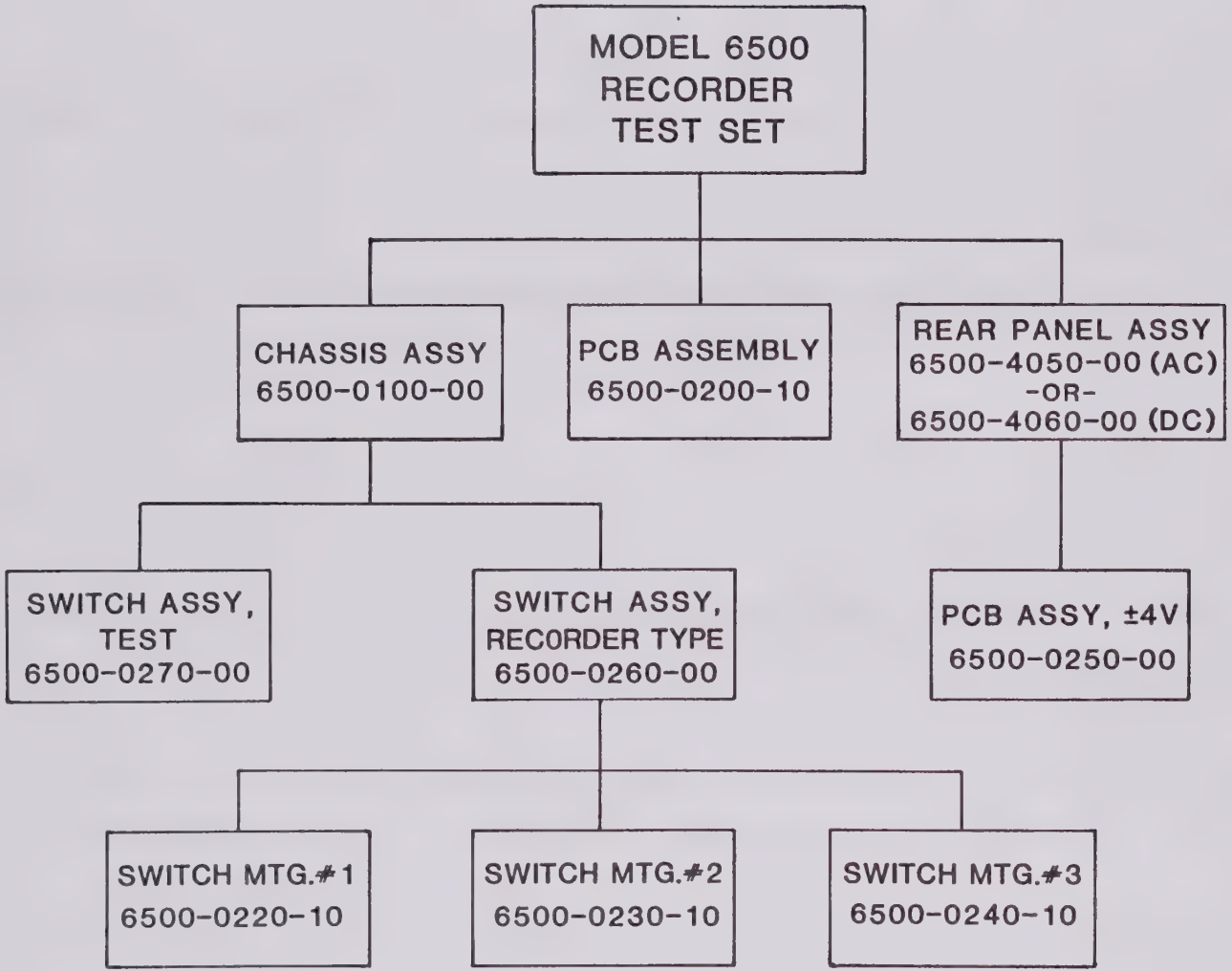
1. A description of the part or assembly, obtained from the parts list.
2. The Data Check part or assembly number, also from the parts list
3. The reference designator, if applicable, given on the applicable schematic or assembly drawing and the parts list.
4. The part or type number of the major assembly shown on the instrument nameplate.

Table 7-1. List of Parts Lists

PART NO.	TITLE	PAGE NO.
Model 6500-AC	Recorder Test Set - AC Power	7-4
Model 6500-DC	Recorder Test Set - DC Power	7-5
6500-0100-00	Chassis Assembly	7-6
6500-0200-10	PCB Assembly	7-7
6500-0220-10	Switch Mtg. No. 1	7-12
6500-0230-10	Switch Mtg. No. 2	7-13
6500-0240-10	Switch Mtg. No. 3	7-14
6500-0250-00	PCB Assembly, ±4V Reg	7-15
6500-0260-00	Switch Assembly, Recorder Type	7-16
6500-0270-00	Switch Assembly, Test	7-17

MFR CODE	MANUFACTURER	LOCATION
02660	Amphenol Division/Bunker-Ramo	Broadview, Illinois
04713	Motorola Semiconductor Products	Phoenix, Arizona
05397	Kemet Division/Union Carbide	Cleveland, Ohio
07263	Fairchild Semiconductor Division	Mt. View, California
14655	Cornell-Dubilier Electronics Div.	Newark, New Jersey
27014	National Semiconductor Corp.	Santa Clara, California
27264	Molex, Inc.	Lisle, Illinois
27556	IMB Electronic Products, Inc.	Santa Fe Springs, California
31918	IEE Schadow, Inc.	Eden Prairie, Minnesota
55792	Data Check Corporation	San Diego, California
60741	Triplett Corporation	Bluffton, Ohio
62462	Capar Components Corporation	Woodbury, New York
71450	CTS Corporation	Elkhart, Indiana
71590	Centralab, Inc.	Ft. Dodge, Iowa
75915	Tracor/Littelfuse, Inc.	Des Plaines, Illinois
81453	Raytheon Company	Quincy, Massachusetts
82389	Switchcraft, Inc.	Chicago, Illinois
83330	Kulka Smith, Inc.	Manasquan, New York
86684	RCA Corp Distribution & Special Products	Cherry Hill, New Jersey
91637	Dale Electronics, Inc.	Columbus, Nebraska

MANUFACTURERS' FEDERAL SUPPLY CODE NUMBERS


MODEL 6500
RECORDER
TEST SET
CHASSIS ASSY
6500-0100-00
PCB ASSEMBLY
6500-0200-10
REAR PANEL ASSY
6500-4050-00 (AC)
-OR-
6500-4060-00 (DC)
SWITCH ASSY,
TEST
6500-0270-00
SWITCH ASSY,
RECORDER TYPE
6500-0260-00
PCB ASSY, ±4V
6500-0250-00
SWITCH MTG.#1
6500-0220-10
SWITCH MTG.#2
6500-0230-10
SWITCH MTG.#3
6500-0240-10

PARTS LIST - MODEL 6500 RECORDER TEST SET - AC POWER

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0100-00	Chassis Assembly	55792	---
1 Req	6500-4050-00	Rear Panel Assy, AC	55792	---
1 Req	6500-0200-00	PCB Assembly	55792	---

PARTS LIST · MODEL 6500 RECORDER TEST SET · DC POWER

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0100-00	Chassis Assembly	55792	---
1 Req	6500-4060-00	Rear Panel Assy, DC	55792	---
1 Req	6500-0200-00	PCB Assembly	55792	---

PARTS LIST - CHASSIS ASSEMBLY - 6500-0100-00

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0260-00	Switch Assembly, Recorder Type	55792	---
1 Req	6500-0270-00	Switch Assembly, Test	55792	---
1 Req	6500-3010-01	Chassis	55792	1-11237
1 Req	6500-3000-01	Cover	55792	1-11232
1 Req	6500-3050-00	Bezel	55792	1-11234
1 Req	6500-3040-00	Window	55792	2-20102
2 Req	6500-5020-00	Shim	55792	1-11236
1 Req	6500-3080-00	Shield, Meter	55792	1-11235
1 Req	MP40008-2	Bail & Feet Assy	55792	4-20395
1 Req	1875-376-370	Handle	55792	4-20396
2 Req	70B-3-2G	Knob, Skirted	81453	4-10104
1 Req	70-1-WD2	Knob, Round	81453	4-10105
1 Req	320GL/B-0-200UA	Meter, 0-200 Microamps	60741	3-60008
R159	JA1G040P104AA	Res, CC, 100K, 1W, 10%	Allen Bradley	5-74104
2 Req	21-010	Connector, BNC	02660	2-29000
2 Req	31-010	Connector, BNC, Insulated	02660	2-29001
1 Req	03-09-2121	Connector	27264	2-30069
8 Req	1380	Pins	27264	2-30066
1 Req	46203LF	Switch, Slide, SPDT	82389	2-10061
1 Req	ZFFA200-8U0A	Switch, Pushbutton, Momentary, 8 PDT	31918	2-10098
1 Req	ZFFA200-4UEE	Switch, Pushbutton Pwr Alt Action	31918	2-10099
3 Req	1410-6	Terminal Lug #6	83330	4-70114
6 Req	1497	Solder Lug, BNC	83330	4-30120
2 Req	1410-4	Terminal Lug	83330	4-70123
2 Req	1410-14	Solder Lug, 1/4"	83330	4-30156
1 Req	6500-5010-00	Clip	55792	4-20409
2 Req	8410	Spacer, Thd, 4-40 x 1.75	83330	4-20408
1 Req	---	Technical Manual-6500	55792	4-20407

PARTS LIST - PCB ASSEMBLY - 6500-0200-10

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0205-10	Etched Circuit Board	55792	1-20973
		CAPACITORS		
C1	BA2A163F	MM, .016uF, 50V	27556	6-46163
C2	BA2A163F	MM, .016uF, 50V	27556	6-46163
C3	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C4	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C5	CLE-10-25	Elect, 10uF, 25V, 20%	62462	6-84106
C6	BA2A163F	MM, .016uF, 50V	27556	6-46163
C7	BA2A163F	MM, .016uF, 50V	27556	6-46163
C8	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C9	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C10	CLE-1-50	Elect, 1uF, 50V, 20%	62462	6-86105
C11	CM05ED102J03	DM, 1000pF, 100V	14655	6-19102
C12	CM05ED102J03	DM, 1000pF, 100V	14655	6-19102
C13	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C14	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C15	CLE-1-50	Elect, 1uF, 50V, 20%	62462	6-86105
C16	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C17	ZA2C104	MM, .1uF, 200V	27556	6-47104
C18	UK10-503	CD, .05uF, 10V	71590	6-24503
C19	CLE-4.7-35	Elect, 4.7uF, 35V, 20%	62462	6-85475
C20	CLE-4.7-35	Elect, 4.7uF, 35V, 20%	62462	6-85475
C21	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C22	CLE-4.7-35	Elect, 4.7uF, 35V, 20%	62462	6-85475
C23	CLE-4.7-35	Elect, 4.7uF, 35V, 20%	62462	6-85475
C24	CM05ED102J03	DM, 1000pF, 100V	14655	6-19102
C25	CLE-1-50	Elect, 1uF, 50V, 20%	62462	6-86105
C26	CLE-10-25	Elect, 10uF, 25V, 20%	62462	6-84106
C27	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C28	CLE-220-6	Elect, 220uF, 6V, 20%	62462	6-81227
C29	CLE-1000-3	Elect, 1000uF, 3KV	62462	6-80108
C30	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C31	CLE-330-10	Elect, 330uF, 10V, 20%	62462	6-82337
C32	XA2C123J	MM, .012uF, 200V, 5%	27556	6-47123
C33	XA2C563J	MM, .056uF, 200V, 5%	27556	6-46563
C34	CM05ED471J03	DM, 470pF, 500V	14655	6-19471
C35	UK10-503	CD, .05uF, 10V	71590	6-24503
C36	XA2A103J	MM, .01uF, 50V	27556	6-46103
C37	XA2A103J	MM, .01uF, 50V	27556	6-46103
C38	XA2A103J	MM, .01uF, 50V	27556	6-46103
C39	UK10-503	CD, .05uF, 10V	71590	6-24503
C40	UK10-503	CD, .05uF, 10V	71590	6-24503
C41	XA2A103J	MM, .01uF, 50V	27556	6-46103
C42	XA2A103J	MM, .01uF, 50V	27556	6-46103
C43	CLE-15-25	Elect, 15uF, 25V, 20%	62462	6-84156
C44	XA2C124J	MM, .12uF, 200V	27556	6-47124

PARTS LIST - PCB ASSEMBLY - 6500-0200-10 (CONTINUED)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
R89	RN55D1910F	MF, 191 ohm, 1/8W, 1%	91637	5-51123
R90	RN55D1001F	MF, 1K ohm, 1/8W, 1%	91637	5-51193
R91	RN55D3322F	MF, 33.2K ohm, 1/8W,1%	91637	5-51349
R92	RN55D2001F	MF, 2K ohm, 1/8W, 1%	91637	5-51222
R93	RN55D332RF	MF, 332 ohm, 1/8W, 1%	91637	5-51146
R94	RN55D3010F	MF, 301 ohm, 1/8W, 1%	91637	5-51142
R95	RN55D4751F	MF, 4.75K ohm, 1/8W,1%	91637	5-51268
R96	RN55D1501F	MF, 1.5K ohm, 1/8W, 1%	91637	5-51210
R97	RN55D1003F	MF, 100K ohm, 1/8W, 1%	91637	5-51394
R98	RN55D3012F	MF, 30.1K ohm, 1/8W,1%	91637	5-51345
R99	RN55D1002F	MF, 10K ohm, 1/8W, 1%	91637	5-51299
R100-R102	RN55D3322F	MF, 33.2K ohm, 1/8W,1%	91637	5-51349
R103	RN55D1003F	MF, 100K ohm, 1/8W, 1%	91637	5-51394
R104	89PR2K	Cer,Var, 2K, 3/4W, 10%	71450	5-76202
R105	RN55D3011F	MF, 3.01K ohm, 1/8W,1%	91637	5-51239
R106	RN55D1003F	MF, 100K ohm, 1/8W, 1%	91637	5-51394
R107	RN55D1213F	MF, 121K ohm, 1/8W, 1%	91637	5-51402
R108	RN55D4752F	MF, 47.5K ohm, 1/8W,1%	91637	5-51364
R109	89PR2K	Cer,Var, 2K, 3/4W, 10%	71450	5-76202
R110	RN55D3922F	MF, 39.2K ohm, 1/8W,1%	91637	5-51356
R111	RCR07G105JR	CC, 1M ohm, 1/4W, 5%	91637	5-10105
R112-R113	RCR07G106JR	CC, 10M ohm, 1/4W, 5%	91637	5-10106
R114	RCR07G105JR	CC, 1M ohm, 1/4W, 5%	91637	5-10105
R115	RCR07G395JR	CC, 3.9M ohm, 1/4W,5%	91637	5-10395
R157	RN55D8251F	MF, 8.25K ohm, 1/8W,1%	91637	5-51291
R158	RN55D1502F	MF, 15K ohm,1/8W, 1%	91637	5-51316
		DIODES		
CR1	1N914	GP, Signal	07263	3-10914
CR2	1N270	Signal	07263	3-10270
CR3-CR4	1N914	GP, Signal	07263	3-10914
CR5-CR6	1N270	Signal	07263	3-10270
CR7-CR8	1N914	GP, Signal	07263	3-10914
CR9	1N270	Signal	07263	3-10270
CR10-CR13	1N914	GP, Signal	07263	3-10914
VR1	1N746A	Zener, 3.3V, 400MV	07263	3-10746
		TRANSISTORS		
Q1	U2745E	SI, N-Chan, 20V, 5MA	04713	3-22745
Q2	2N3565	NPN, Signal	27014	3-23565
Q3 - Q5	U2745E	SI, N-Chan, 20V, 5MA	04713	3-22745
Q6	2N4917	PNP	07263	3-24917
Q7	2N5640	FET. N-Chan	04713	3-25640
Q8	2N4917	PNP	07263	3-24917
Q9 - Q11	U2745E	SI, N-Chan, 20V, 5MA	04713	3-22745

PARTS LIST - PCB ASSEMBLY - 6500-0200-10 (CONTINUED)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
Q12-Q13	2N3391	SI, NPN, Pwr, 25VCB	04713	3-23391
Q14-Q15	2N4917	PNP	07263	3-24917
		IC's		
U1-U4	SN741P	Linear, Gen Pur Amp	07263	3-30741
U5	MC1496L	Bal Modulator	04713	3-31496
U6	SN741P	Linear, Gen Pur Amp	07263	3-30741
U7	CD4046AE	Micro Pwr, Phase-Locked Loop	86684	3-34046
U8 - U10	SN741P	Linear, Gen Pur Amp	07263	3-30741
		MISCELLANEOUS		
T1	AR-162	Transformer, AF, 150	55792	7-61005
2 Req	MS51957-14	Screw, Pnhd, 4-40 x 5/16	55792	4-60103
2 Req	MS15795-804	Washer, Flat, #4	55792	4-70108
2 Req	MS35333-70	Washer, Int Lk, #4	55792	4-70100
2 Req	NAS671-C4	Nut, Plain Hex, 4-40	55792	4-70104

PARTS LIST - SWITCH MTG. NO. 1 - 6500-0220-10

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0225-10	Etched Circuit Board	55792	1-20974
1 Req	5P3427	Section, Wafer, 4 Pole 2-3 Position	71450	2-11000
		RESISTORS		
R131-R133	89PR100K	Cer,Var, 100K,3/4W,10%	71450	5-76104
R134	RN55D1653F	MF, 165K ohm, 1/8W,1%	91637	5-51415
R135	RN55D9311F	MF, 9.31K ohm,1/8W,1%	91637	5-51296
R136	RN55D1872F	MF, 18.7K ohm,1/8W,1%	91637	5-51325
R137	RN55D3742F	MF, 37.4K ohm,1/8W,1%	91637	5-51354
R138	RN55D5232F	MF, 52.3K ohm,1/8W,1%	91637	5-51368
R139	RN55D1002F	MF, 10K ohm, 1/8W, 1%	91637	5-51299
R140	RN55D1653F	MF, 165K ohm, 1/8W,1%	91637	5-51415
R141	RN55D9311F	MF, 9.31K ohm,1/8W,1%	91637	5-51296
R142	RN55D1872F	MF, 18.7K ohm,1/8W,1%	91637	5-51325
R143	RN55D3742F	MF, 37.4K ohm,1/8W,1%	91637	5-51354
R144	RN55D5232F	MF, 52.3K ohm,1/8W,1%	91637	5-51368

PARTS LIST - SWITCH MTG. NO. 2 - 6500-0230-10

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0235-10	Etched Circuit Board	55792	1-20975
1 Req	5P3427	Section-Wafer, 4 Pole, 2-3 Position	71450	2-11000
		RESISTORS		
R116	RN55D4992F	MF, 49.9K ohm, 1/8W,1%	91637	5-51366
R117	RN55D1003F	MF, 100K ohm, 1/8W, 1%	91637	5-51394
R118	RN55D2003F	MF, 200K ohm, 1/8W, 1%	91637	5-51423
R119	RN55D4992F	MF, 49.9K ohm, 1/8W,1%	91637	5-51366
R120	RN55D1003F	MF, 100K ohm, 1/8W, 1%	91637	5-51394
R121	RN55D2003F	MF, 200K ohm, 1/8W, 1%	91637	5-51423
R148	89PR10K	Cer,Var, 10K, 3/4W, 10%	71450	5-76103
R149	3006P-1-503	Cer,Var, 50K, 3/4W, 10%	71450	5-76503
R150	89PR2K	Cer,Var, 2K, 3/4W, 10%	71450	5-76202
R151-R153	3006P-1-501	Cer,Var, 500 ohm, 3/4W, 10%	71450	5-76501
R154-R156	3006P-1-502	Cer,Var, 5K, 3/4W, 10%	71450	5-76502

PARTS LIST - SWITCH MTG. NO. 3 - 6500-0240-10

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0245-10	Etched Circuit Board	55792	1-20976
1 Req	5P3427	Section-Wafer, 4 Pole, 2-3 Position	71450	2-11000
		RESISTORS		
R122	RN55D3922F	MF, 39.2K ohm, 1/8W, 1%	91637	5-51356
R123	RN55D2002F	MF, 20K ohm, 1/8W, 1%	91637	5-51328
R124	RN55D9761F	MF, 9.76K ohm, 1/8W, 1%	91637	5-51298
R125	RN55D3922F	MF, 39.2K ohm, 1/8W,1%	91637	5-51356
R126	RN55D2002F	MF, 20K ohm, 1/8W, 1%	91637	5-51328
R127	RN55D9761F	MF, 9.76K ohm, 1/8W, 1%	91637	5-51298
R128-R130	89PR100K	Cer,Var, 100K, 3/4W,10%	71450	5-76104
R145-R147	3006P-1-503	Cer,Var, 50K, 3/4W, 10%	71450	5-76503

PARTS LIST · PCB ASSEMBLY · ±4V REG. · 6500-0250-00

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0255-00	Etched Circuit Board	55792	1-20977
		RESISTORS		
R1	RN55D2001F	MF, 2K ohm, 1/8W, 1%	91637	5-51222
R2 - R4	RN55D1003F	MF, 100K ohm, 1/8W, 1%	91637	5-51394
R5	RN55D1501F	MF, 1.5K ohm, 1/8W, 1%	91637	5-51210
		CAPACITORS		
C1-C3	CLE-100-10	Elect, 100uf, 10V, 20%	62462	6-82107
C4-C6	T362B335M035AS	Tant, 3.3uf, 25V	05397	6-88335
		TRANSISTORS		
Q1	2N2219A	NPN, Switch	04713	3-22219A
Q2	2N2905	PNP, Signal	04713	3-22905
		DIODES		
CR1-CR4	1N4004	Power, 1A, 400V	07263	3-14004
VR1	1N749A	Zener, 4.3V, 400MW	07263	3-10749
VR2	1N750	Zener, 4.7V, 400MW	07263	3-10750
		MISCELLANEOUS		
T1	6500-4000-00	Transformer, Power	55792	7-61006
U1-U2	741TC	IC, Amplifier	07263	3-30741
J1	03-09-1122	Conn, Recpt, w/o Tabs, Ears, 12C	27264	2-30067
12 Req	1377TL	Soc, Contact, PC Tail Style	27264	2-30068

PARTS LIST - SWITCH ASSEMBLY - RECORDER TYPE - 6500-0260-00				
REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-0220-10	Switch Mtg. No. 1	55792	---
1 Req	6500-0230-10	Switch Mtg. No. 2	55792	---
1 Req	6500-0240-10	Switch Mtg. No. 3	55792	---
1 Req	6500-4050-00	Switch, Recorder Type	55792	2-10100M

PARTS LIST · SWITCH ASSEMBLY · TEST · 6500-0270-00

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-5050-00	Switch	55792	2-10097M
9 Req	T5	Wafer,Switch, 1 Pole, 12 Position	71450	2-11001
2 Req	8300-6160-00	Shield, Switch	55792	1-11233
R200	RN55D2743F	MF, 274K ohm, 1/8W,1%	91637	5-51436
1 Req	1410-14	Lug, Solder, 1/4"	83330	4-30156

PARTS LIST · REAR PANEL ASSEMBLY · AC POWER · 6500-4050-00

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-3020-01	Rear Panel	55792	1-11233
1 Req	6500-0250-00	PCB Assembly, ±4V Reg	55792	---
1 Req	46206LFR	Switch, Slide, 115/230	82389	2-10025
1 Req	342004A	Fuse Holder	75915	2-40000
1 Req	313.062	Fuse, 1/16 Amp, Slo-Blo	75915	2-40011
1 Req	17405B	Power Cord	55792	2-70000
1 Req	SR-6P3-4	Retainer, Power Cord	55792	2-45002

PARTS LIST · REAR PANEL ASSEMBLY · DC POWER · 6500-4060-00

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	DATA CHECK PART NO.
1 Req	6500-3070-00	Rear Panel	55792	1-11238
1 Req	6500-4040-00	Battery Clamp	55792	4-20410
1 Req	6500-3090-10	Label, Polarity ID	55792	4-20373
1 Req	03-09-1122	Connector, Recpt, w/o Tabs, Ears, 12C	27264	2-30067
8 Req	1381TL	Socket, Conn, for .093 Dia Pin	27264	2-30070

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DATA CHECK CORPORATION warrants each instrument manufactured by it to be free from defects in material and workmanship under normal use and service for the period of one year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, batteries, or any products or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, Data Check Corporation will repair and calibrate an instrument returned to the factory within one year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within one year of the original purchase, said repairs or replacement will be made without charge. If the fault has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken:

1. *Notify Data Check Corporation, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.*

2. *On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the factory and the instrument returned to you.*

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The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be forwarded to Data Check Corporation. Upon receipt of this report, you will be advised of the disposition of the equipment for repair or replacement. Include the model number and serial number when referring to this instrument for any reason.

Data Check Corporation will be happy to answer all application or use questions which will enhance your use of this instrument. Please address your requests or correspondence to:

Attn: Sales Department
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